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ANNUAL REPORTS

OF THE

BOARD OF HARBOR COMMISSIONERS

OF THE

Commonwealth of Massachusetts.

(FIRST TO TENTH, INCLUSIVE.)

ALSO,

ACTS AND RESOLVES OF THE LEGISLATURE

RELATING TO THE

BOARD OF HARBOR COMMISSIONERS, AND TO BOSTON AND
OTHER HARBORS OF THE COMMONWEALTH,

FROM

1866 TO 1876.

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ACTS AND RESOLVES

RELATING TO

HARBOR COMMISSIONERS AND CERTAIN HARBORS.

1866-1876.

[Chapter 149, Acts of 1866.]

AN ACT TO ESTABLISH A BOARD OF HARBOR COMMISSIONERS.

SECTION 1. The governor, with the advice and consent of the council, shall, before the first day of July next, appoint five competent persons, who shall constitute a board of harbor commissioners, and who shall hold their offices from the dates of their respective appointment, and for the terms of one, two, three, four and five years, respectively, from the first day of July next. The governor shall, in like manner, before the first day of July in every year, appoint a commissioner to continue in office for the term of five years from said day; and in case of any vacancy occurring in the board, by resignation or otherwise, shall, in the same manner, appoint a commissioner for the residue of the term, and may in the same manner remove any commissioner. And the compensation of each of said commissioners shall not exceed five dollars per day for time actually employed in the service of said commission.

SECT. 2. The board of harbor commissioners shall have the general care and supervision of all the harbors and tide-waters, and of all the flats and lands flowed thereby, within the Commonwealth, except the back bay lands, so called, in the city of Boston, in order to prevent and remove unauthorized encroachments and causes of every kind which are liable to interfere with the full navigation of said harbors, or

in any way injure their channels, or cause any reduction of their tide-waters, and in order to protect and develop the rights and property of the Commonwealth in said flats and lands. They may, from time to time, make such surveys, examinations and observations as they may deem necessary in any harbor for said purpose, and employ for these purposes competent engineers, and also employ such clerical and other assistance as they may think necessary. They shall inquire as to the riparian rights of the owners of land on the northerly shore of South Boston, both as to the flats lying between said shore and the channel, and the rights of navigation over the same ; and to ascertain whether said rights can be extinguished or harmonized with rights claimed by the Commonwealth ; to prepare a plan for the improvement of said flats, and report to the next legislature. They shall have an office in Boston, where the maps, charts and plans connected with the harbors, records of all their doings, and all documents relating to their business, shall be kept.

SECT. 3. Whenever in the judgment of the said board of commissioners the public good requires, they may proceed to prescribe harbor lines in any of the harbors of this Commonwealth, beyond which no wharf, pier or other structure shall be extended into such harbor, and shall report the same for the consideration of the legislature at its next session : *provided, however*, that said commissioners before drawing any such line shall appoint a convenient time and place for the hearing of all parties interested, and shall give notice thereof by publication three weeks successively in two or more newspapers, one of which is published in Boston, and one in the county where such harbor is situated, the first publication to be at least thirty days before the time of hearing.

SECT. 4. All persons that have been or may be authorized by the legislature to build over tide-waters any bridge, wharf, pier or dam, or to fill any flats, or to drive any piles below high-water mark, who have not already begun such work, shall, before beginning it, give written notice to the harbor commissioners of the work they intend to do, and submit plans of any proposed wharf or other structure, and of the flats to be filled, and of the mode in which the work is to be performed ; and no such work shall be commenced until the

plan and mode of performing the same shall be approved in writing by a majority of the said harbor commissioners. And the said commissioners shall have power to alter the said plans at their discretion, and to prescribe the direction, limits, and mode of building the wharves and other structures, to any extent that does not diminish or control the legislative grant; and all such works shall be executed under the supervision of the commissioners. The amount of tide-water displaced by any structure or filling of flats hereafter authorized as aforesaid, shall be ascertained by the harbor commissioners, and they shall, in all cases affecting the harbor of Boston, and in cases affecting other harbors, if they shall deem it necessary, require the parties making the same to make compensation therefor, either by excavating in some part of the same harbor where the work is performed, including tide-water channels between high and low water mark, to such an extent as to create a basin for as much tide-water as may be displaced by such structure or filling of flats, and the same shall be done under their direction, or by paying in lieu of performing the work of dredging to restore the displaced tide-water a sufficient sum of money for making such compensation, or by improving the harbor in any other mode to the satisfaction of the commissioners; and all money thus paid shall be paid into the treasury of the Commonwealth, and be reserved as a compensation fund for the harbor where such compensation is to be made, and used for that purpose under the direction of the commissioners: *provided*, that all dredging made for purposes of such compensation for displaced tide-water shall in no wise injure any existing channels, but as far as practicable shall be directed towards their permanent improvement.

SECT. 5. All erections and works hereafter made without authority from the legislature, or in any manner not sanctioned by the board of harbor commissioners, where their direction is required as herein before provided, within tide-waters flowing into or through any harbor, shall be considered a public nuisance and liable to indictment as such. The board of harbor commissioners shall have power to order suits on behalf of the Commonwealth to prevent or stop, by injunction or otherwise, any such erection or other nuisance in

the tide-waters which flow into or through any harbor in the Commonwealth, or thus to prevent or stop the removal of any material from any bar or breakwater of any such harbor; and the attorney-general and district-attorneys within their districts shall commence and conduct such suit.

SECT. 6. The harbor commissioners are authorized and empowered, whenever they deem it necessary, to apply to congress for appropriations for protecting and improving any harbor in the Commonwealth.

SECT. 7. No contracts shall be made and no acts done by said commissioners which involve the payment of any money from the treasury of the Commonwealth, except as herein provided, without an appropriation expressly made by the legislature for that purpose. They shall keep an account of their actual services and expenses, to be allowed by the governor and council.

SECT. 8. The commissioners shall report in print to the legislature annually, on or before the tenth day of January, their doings during the year preceding, and shall recommend such legislation as they deem necessary for the preservation and improvement of the harbors and the promotion of the interest of the Commonwealth connected therewith; and whenever they shall propose any plan for the improvement of the flats in the harbor of Boston, or to alter any harbor line in the same, they shall furnish to the legislature a copy of the report of the United States commissioners upon the harbor of Boston. [*Approved April 12, 1866.*]

[Chapter 81, Resolves of 1866.]

RESOLVES IN RELATION TO BOSTON HARBOR AND THE COMMONWEALTH
FLATS THEREIN

Resolved, That the plan recommended by the commissioners on harbors and flats in their fourth report, presented at the present session of the legislature, for the occupation of the flats owned by the Commonwealth in Boston harbor, lying northerly of South Boston and easterly of that part of Boston which lies between Long wharf and Arch wharf, is approved and adopted by this legislature; and that the same,

when executed, will greatly improve the harbor of Boston, increase the commercial prosperity of the city, and benefit the Commonwealth.

Resolved, That the harbor commissioners be and they hereby are authorized and directed to ascertain and report to the legislature at its next session, on or before the fifteenth day of January next, the probable cost of the several sections of the outer wall mentioned in said report and laid down on the plan annexed to it, and of building the wharves and filling the flats of the Commonwealth, as laid down on said plan; the expense of dredging in Fort Point Channel, which will be required by the proposed changes therein, and of grading streets and building sewers over and through said flats; also, the probable expense of making compensation for the tidal water to be shut out by the filling of said flats; also to ascertain and report on what terms and conditions the said walls, wharves, streets, sewers, or any parts thereof, can be built by any corporations or individuals, and on what terms and conditions the said flats, or any parts thereof, can be filled, and on what terms and conditions the said flats or any parcels thereof, can be sold to any corporations or individuals, either for money or for filling other portions of said flats, and in what places and manner compensation for the tide-water shut out by filling said flats can best be made, and on what terms and conditions persons whose lands are to be affected by said compensation, will give authority to make the same; also, on what terms and conditions the rights and interests of the riparian proprietors in South Boston and others, can be harmonized with the proposed occupation and improvement of said flats; also to report any other matters which said commissioners consider as material in regard to the occupation of said flats; the said commissioners in all plans and proposals submitted by them, always regarding the protection and improvement of the harbor of Boston as of paramount importance, in any intended occupation of said flats.

Resolved, That the harbor commissioners be authorized to contract with the city of Boston for the construction of the whole or any part of the Eastern Avenue, and to make payment therefor by conveying such portions of the flats belong-

ing to the Commonwealth, northerly of the South Boston shore, as shall be deemed necessary for the said purpose: *provided*, that compensation for all tide-water excluded by carrying into effect these resolves shall be duly made as provided in the act to establish a board of harbor commissioners: *provided*, that the terms of any contract and conveyance shall be subject to the approval of the governor and council; and *provided*, that no money shall be paid from the treasury of the Commonwealth: *provided, also*, that nothing shall be done under this resolve which shall conflict with the plan of the South Boston flats accompanying the report of the commissioners on harbors and flats of the Commonwealth of Massachusetts, presented to the legislature on the sixth day of January in the year eighteen hundred and sixty-six, or which shall conflict with the reports of the United States commissioners. [*Approved May 18, 1866.*]

[Chapter 354, Acts of 1867.]

AN ACT FOR THE IMPROVEMENT OF THE HARBOR OF BOSTON AND THE COMMONWEALTH'S FLATS THEREIN.

SECTION 1. The board of harbor commissioners is hereby authorized and empowered to contract with any responsible person or persons for the construction of a continuous sea-wall upon the flats of the Commonwealth in Boston harbor, as hereinafter described. They are also authorized and empowered to contract for the dredging and deepening of such flats as are in front of said sea-wall, for the purpose of filling so much of the flats of the Commonwealth as may be included within a line behind said wall, and parallel therewith, such filling to be extended inwardly only so far as may be necessary to support the sea-wall, and upon the following terms and conditions. The sea-wall shall be commenced at or near the point of intersection of the line marked A on the commissioners' line, established by chapter three hundred and eighty-five of the acts of the year one thousand eight hundred and fifty-three, with the easterly line of Fort Point Channel, and shall be built from that point, and within and parallel with the exterior line to the point known as Slate Ledge, as

laid down on the plan for the occupation of the flats owned by the Commonwealth in Boston harbor, approved by the legislature in the eighty-first chapter of the resolves of the year one thousand eight hundred and sixty-six, or upon any modifications of said plan hereafter made.

SECT. 2. The board of harbor commissioners shall have authority to modify the line between point A and the point where the curve strikes the exterior line recommended by the United States commissioners on Boston harbor, and the sea-wall shall be built in accordance with the line so modified.

* [SECT. 3. An engineer shall be appointed by the governor, whose duty it shall be to prepare plans and specifications for proposals and contracts for the construction of said sea-wall, dredging and filling. He shall consult with the harbor commissioners, and shall locate said wall and decide upon the amount of dredging and width of filling behind the sea-wall, having due regard for economy and strength, as well as the proper direction of the currents in Boston harbor. All plans and specifications for contracts prepared by said engineer, shall be submitted to the governor and council; and if approved by them, the commissioners shall advertise for proposals for the work; which proposals shall be submitted to the governor and council; and when any proposals are approved and accepted by them, the commissioners shall sign such contract as the representatives of the Commonwealth. The engineer shall have the superintendence of all the works to be done in pursuance of this act, under the direction of the board of harbor commissioners. The compensation of the engineer shall be fixed by the governor and council.]

SECT. 4. All license and authority to the Boston Wharf Company to extend their wharf over so much of the territory referred to in section one of chapter four hundred and fifty-five of the acts of the year eighteen hundred and fifty-five, as lies between lines marked A and B, described in chapter three hundred and eighty-five of the acts of the year eighteen hundred and fifty-three, are hereby revoked, except so far as substantial structures may have been erected by said company thereon.

* Sections 3 and 5 of this Act are repealed by section 9, chapter 326 of the Acts of the year 1868.

* [SECT. 5. It shall be the duty of the engineer appointed under this act, to cause hydrographical surveys to be made, from time to time, for the purpose of determining the effect upon the harbor of the structures and filling in connection with the dredging herein authorized, and in case it shall appear that the same injuriously affect the harbor, by reason of the displacement of tide-water, compensation shall be made therefor, in such manner and to such an extent as the legislature shall hereafter determine.]

SECT. 6. For the works to be done under this act, the sum of two hundred thousand dollars is hereby appropriated, and shall be allowed and paid.

SECT. 7. This act shall take effect upon its passage.
[*Approved June 1, 1867.*]

[Chapter 190, Acts of 1867.]

AN ACT RESPECTING THE OCCUPATION OF FLATS IN THE HARBOR OF GLOUCESTER.

SECTION 1. All persons owning flats in the harbor of Gloucester are hereby authorized to extend and maintain wharves upon the same, or to fill up and build upon the same, but not beyond the harbor lines there now established.

SECT. 2. All persons owning flats in the harbor of Gloucester, whose outer lines of title are the low-water mark, or one hundred rods below the high-water mark, may extend and maintain wharves over any flats of the Commonwealth that may lie between their said outer lines and the harbor lines there now established, but in such manner that all persons affected by this grant may have equal proportionate rights of advancing to or toward the said harbor lines.

SECT. 3. All things which may at any time be done under this grant, shall be subject to the determination and approval of the board of harbor commissioners, as provided in section four of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six.

SECT. 4. If the harbor lines of Gloucester shall at any time be removed nearer to the high-water mark, this grant

* Sections 3 and 5 of this Act are repealed by section 9, chapter 326 of the Acts of the year 1868.

shall be construed to apply only to such new lines, except so far as valuable structures may have been actually and in good faith built under the same.

SECT. 5. When in any previous grant of a right to extend and maintain a wharf in Gloucester harbor, liberty has been given to lay vessels at the sides or end of such wharf, the liberty so granted shall not be construed as a grant of any private right in or over the flats of any other person, or of any private right in or over the flats of the Commonwealth not revocable at any time by the legislature.

SECT. 6. The grants made by this act are revocable by the legislature at any time, except so far as valuable structures may have been actually and in good faith built under the same.

SECT. 7. This act shall take effect upon its passage.
[*Approved April 30, 1867.*]

[Chapter 210, Acts of 1867.]

AN ACT CONCERNING THE OCCUPATION OF FLATS IN CAPE COD HARBOR
AT PROVINCETOWN.

SECTION 1. All persons owning flats in Cape Cod harbor at Provincetown, are hereby authorized to extend and maintain wharves upon the same, or to fill up and build upon the same, but not beyond the harbor lines which may be hereafter established for said harbor.

SECT. 2. All persons owning flats in the harbor at Provincetown, whose outer lines of title are the low-water mark, or one hundred rods below the high-water mark, may extend and maintain wharves over any flats of the Commonwealth that may lie between their outer lines and the harbor lines that may be there hereafter established, but in such manner that all persons affected by this grant may have equal proportionate rights of advancing to or towards the said harbor lines.

SECT. 3. All things which may at any time be done under this grant, shall be subject to the determination and approval of the board of harbor commissioners, as provided in section four of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six.

SECT. 4. If the harbor lines at Provincetown shall at any time be removed nearer to the high-water mark, this grant shall be construed to apply only to such new lines, except so far as valuable structures may have been actually and in good faith built under the same.

SECT. 5. When in any previous grant of a right to extend and maintain a wharf in the harbor at Provincetown, liberty has been given to lay vessels at the sides or end of such wharf, the liberty so granted shall not be construed as a grant of any private right in or over the flats of any person or of the Commonwealth, not revocable at any time by the legislature.

SECT. 6. The grants made by this act are revocable by the legislature at any time, except so far as valuable structures may have been actually and in good faith built, under the same.

SECT. 7. This act shall take effect upon its passage.
[*Approved May 4, 1867.*]

[Chapter 326, Acts of 1868.]

AN ACT IN ADDITION TO "AN ACT FOR THE IMPROVEMENT OF THE HARBOR OF BOSTON AND THE COMMONWEALTH'S FLATS THEREIN."

SECTION 1. The harbor commissioners are hereby authorized to contract, in the name of the Commonwealth, with any person or persons, or with the city of Boston, for the filling of any portion of the lands or flats in Boston harbor which lie northerly of South Boston and easterly of Fort Point Channel, and within the exterior line laid down on the plan for the occupation of the flats owned by the Commonwealth in Boston harbor, approved by the legislature in the eighty-first chapter of the resolves of the year eighteen hundred and sixty-six, and for the building of wharves, docks, sea-walls, basins, streets, bridges or sewers, and for dredging or doing any work upon or in relation to said flats, and to pay for the same by conveyances of any portion of said flats, or the granting of any rights or privileges therein, and for laying out and building streets and sewers to and over said flats or any part thereof, reserving and laying out channels; and they may

authorize any corporations or persons to lay and use railroad tracks over any parts of said flats, for the purpose of transporting materials for filling up the said flats, and of any other work in relation thereto, and shall have full power to determine and settle, by agreement, arbitration or process of law, the relative rights and interests of the Commonwealth and all other parties in and to and over said flats and parts thereof; and said commissioners shall have power to enter into any contracts in regard to the occupation and improvement of said flats which said commissioners think best: *provided*, that every conveyance made and the terms thereof, every contract entered into, every authority given for laying railroad tracks and otherwise, every plan for the occupation of said flats, and building docks, sea-walls, basins, wharves, streets and sewers thereon, adopted by said commissioners, shall be submitted to the governor and council, and shall not be binding on the Commonwealth, and shall not have any force or effect until the same have been approved by the governor and council.

SECT. 2. Said commissioners may make any contract which they think judicious, with any of the riparian owners in South Boston, and with the Boston Wharf Company, for the purchase or exchange of lands or flats, and they shall have full authority to release for money or other valuable consideration, upon such terms and conditions as they shall deem fit, and convey by deed, with warranty or otherwise, to be duly executed by them in behalf of the Commonwealth, the right, title and interest of the Commonwealth in the whole or any part of said lands or flats; but all sales of lands or flats, unless otherwise ordered by the governor and council, shall be by public action, and the manner, terms and conditions of such sales shall be prescribed by the governor and council.

SECT. 3. The sea-wall authorized to be erected under chapter three hundred and fifty-four of the acts of the year eighteen hundred and sixty-seven may be commenced at any point on Fort Point Channel considered expedient by the commissioners, and shall be built on the exterior line laid down on the plan designated in said act, as subsequently modified, or within said line at a distance not exceeding fifty feet there-

from. Said wall may be constructed with openings in the same, filled with sheet pilings or otherwise, between such points as said board shall determine. And said commissioners may erect a suitable temporary bulkhead of wood to retain the dredged material, previous to the construction of said wall, at such a distance in the rear thereof as will not interfere with the construction of said wall and the docks and wharves connected therewith. And the commissioners may use the unexpended balance of the appropriation made in the acts aforesaid for these purposes.

SECT. 4. All contracts for filling section one, as shown upon plan number one, dated the twelfth day of December, in the year eighteen hundred and sixty-seven, annexed to the report of the committee on the Commonwealth flats, near South Boston, appointed under chapter ninety-three of the resolves of the year eighteen hundred and sixty-seven, shall require the whole of that portion of the upper harbor of Boston, colored red upon plan number two, annexed to said report, to be dredged, as nearly as practicable, to the depth of twenty-three feet below mean low-water thereon, and the materials thus obtained to be used in filling said section one. And all contracts for filling sections two and three, as shown upon said plan number one, shall require a portion of said upper harbor to be dredged in the same manner and to the same depth as aforesaid, and the materials thus obtained to be used in filling said sections two and three; and the number of cubic yards of material so required to be dredged and used in filling said sections two and three, respectively, shall bear the same proportion to the respective areas of said sections two and three that the number of cubic yards herein required to be dredged from said locality, colored red, shall bear to the area of said section number one. All said contracts for filling said sections shall require the additional materials therefor to be dredged from the reserve channel, as shown upon said plan number two, and also from such other parts of the harbor or taken from such other sources as said commissioners may deem expedient. And the dredging so done in said upper harbor shall be full compensation for the tide-water displaced by the work authorized under this act: *provided, however*, if it shall appear from hydrographical and

physical surveys that injury to the harbor has resulted from the work herein authorized, then such injury shall be repaired, by dredging or otherwise, in such manner and to such an extent as the legislature shall hereafter determine.

SECT. 5. All money received from the sale of lands and flats or otherwise, under this act, shall be paid into the treasury of the Commonwealth, and shall be applied to the sinking fund as provided for by section three of chapter one hundred and twenty-two of the acts of the year eighteen hundred and sixty-five.

SECT. 6. The city of Boston is hereby authorized to build and lay out as a public street, Eastern Avenue, with a bridge over Fort Point Channel, having suitable draws, said avenue and bridge to be located and constructed at such places and upon such plans and upon such terms and conditions as the harbor commissioners may make, the same to be subject to the approval of the governor and council.

SECT. 7. All plans and specifications for the improvement of the flats and for work in connection therewith, and all contracts made in carrying out the authority given by this act shall be subject to the approval of the governor and council.

SECT. 8. Nothing herein contained shall authorize said commissioners, by any stipulation or contract, to require the payment of any money from the treasury of the Commonwealth except as provided in the third section of this act.

SECT. 9. Chapter ninety-three of the resolves of the year eighteen hundred and sixty-seven, also sections three and five of the three hundred and fifty-fourth chapter of the acts of the year eighteen hundred and sixty-seven are hereby repealed.

SECT. 10. This act shall take effect upon its passage.
[*Approved June 9, 1868.*]

[Chapter 446, Acts of 1869.]

AN ACT TO AUTHORIZE THE PURCHASE OF CERTAIN LANDS FOR THE BENEFIT OF THE FLATS OF THE COMMONWEALTH IN BOSTON HARBOR.

SECTION 1. For the purpose of making more available for sale the flats of the Commonwealth, in the harbor of Boston, and perfecting the improvement of the same, the powers

conferred on the harbor commissioners by section two of chapter three hundred and twenty-six of the acts of the year eighteen hundred and sixty-eight, are hereby so far enlarged that said commissioners are authorized to purchase for, and in the name of the Commonwealth, any lands and flats on the notherly shore of South Boston, lying westerly of the easterly line of E Street extended, and extinguish by purchase any claims to title in such lands and flats ; and they shall have full power to determine and settle by agreement, arbitration or process of law the rights and interests which the Commonwealth has or shall acquire in any of said lands and flats and any parts thereof. Such lands and flats shall be subject to the same provisions of sections one, two, four and seven of said chapter, as the lands and flats in Boston harbor described in said first section, and the harbor commissioners shall have the same powers in relation thereto.

SECT. 2. Section one of the South Boston flats described in the fourth section of said act, is hereby enlarged so as to include the lands and flats acquired under this act, and the harbor commissioners may authorize the occupation and improvement of said section one without any reservation for a channel, and without requiring any dredging from a reserve channel.

SECT. 3. All purchases and contracts made under the provisions of this act shall be subject to the approval of the governor and council, and no obligation shall be assumed in behalf of the Commonwealth as a consideration for any such purchase beyond that of providing for the filling so much of the flats acquired under this act as shall be sufficient for a suitable street along the southerly line of such flats whenever the flats from the shore to such line shall have been filled by the riparian owners.

SECT. 4. There shall be allowed and paid out of the treasury of the Commonwealth a sum not exceeding three hundred thousand dollars, to be expended in making the purchases herein authorized, and the same is hereby appropriated.

SECT. 5. The net proceeds of the sales of all lands purchased under authority of this act, and of all lands contained in section one of the South Boston flats referred to in the fourth section of chapter three hundred and twenty-six of the

acts of the year eighteen hundred and sixty-eight, after deducting therefrom all sums of money paid for the purchase of the lands acquired under authority of this act, with interest, shall be paid into the sinking funds established by chapter three hundred and thirteen of the acts of the year eighteen hundred and sixty-four, and chapter one hundred and twenty-two of the acts of the year eighteen hundred and sixty-five.

SECT. 6. For the purposes of this act, the treasurer and receiver-general, under the direction of the governor and council, is hereby authorized to issue scrip or certificates of debt, in the name and on the behalf of the Commonwealth, and under his signature and the seal of the Commonwealth, to an amount not exceeding three hundred thousand dollars, and for a term not exceeding five years, the principal and interest payable in gold in the city of Boston. Said scrip shall be issued in the form of registered bonds, or in the form of certificates of debts, with interest coupons attached, as the governor and council shall decide, and shall bear an annual interest of five per cent., payable semi-annually on the first days of January and July in each year, and shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, redeemable at maturity; and shall be sold and disposed of in such manner, and at such times, and in such pieces and amounts, as the governor and council shall deem for the best interests of the Commonwealth.

SECT. 7. This act shall take effect upon its passage.
[Approved June 22, 1869.]

[Chapter 335, Acts of 1871.]

AN ACT FOR THE IMPROVEMENT OF NAVIGATION IN SOUTH BAY AND
 THE MODIFICATION OF ITS HARBOR LINES.

SECTION 1. The board of harbor commissioners is hereby authorized to license any person to drive piles, build a wharf, wall, pier or other structure in tide-water on land and flats in that part of Boston harbor called South Bay, or to fill such land and flats to such harbor lines as the harbor commissioners shall fix and determine, subject to the approval of the

governor and council, any existing harbor lines on South Bay to the contrary notwithstanding: *provided however*, that no person shall drive any piles, build a wharf, wall, pier, or other structure or do any filling in tide-water on such land and flats, except in accordance with the terms of such license and subject to the provisions of section four of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six and of chapter four hundred and thirty-two of the acts of the year eighteen hundred and sixty-nine; and *provided, further*, that nothing contained in this act shall be construed to affect or take away any private rights which cannot lawfully be affected or taken away without compensation therefor; and said commissioners are hereby authorized to make agreements with any claimants of lands and flats in said South Bay to secure the establishment of such line or lines, and may make and receive conveyance of lands or flats in said South Bay in execution of such agreements: *provided*, such agreements are approved by the governor and council, but this shall not authorize any agreement to pay any money from the treasury of the Commonwealth.

SECT. 2. The said board of commissioners is hereby empowered to authorize any person at his own expense to dredge material out of South Bay within such limits as may be designated by the board.

SECT. 3. This act shall take effect upon its passage.
[Approved May 5, 1871.]

[Chapter 91, Resolves of 1871.]

RESOLVE CONCERNING THE COMMONWEALTH FLATS NEAR SOUTH BOSTON.

Resolved, That the harbor commissioners, after consultation with the governor, the Boston and Albany Railroad Company and the Boston Wharf Company, prepare a plan for the development and improvement of the flats of the Commonwealth, near South Boston, in which development and improvement the Commonwealth and said companies may coöperate; and in connection therewith said commissioners consider the expediency of authorizing or requiring a temporary bulkhead to be built instead of a sea-wall on or near the

exterior line (so called), and also the expediency of filling South Bay and Fort Point Channel; together with such other matters connected with the improvement of said flats as may be important to the interests of the Commonwealth; and said commissioners shall report in print to the next legislature on or before the fifteenth day of January next. [*Approved May 26, 1871.*]

[Chapter 236, Acts of 1872.]

AN ACT TO REGULATE THE BUILDING OF WHARVES AND OTHER STRUCTURES IN TIDE-WATERS.

SECTION 1. Any person may build or extend a wharf, or construct a pier, dam, sea-wall, road, bridge or other structure, fill land or flats, or drive piles in or over tide-water below high-water mark, within the line of riparian ownership, on any shore, and within whatever harbor lines there may be at the time established by law along such shore: *provided*, the license of the board of harbor commissioners is first obtained in a manner provided by the fourth section of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six.

SECT. 2. The board of harbor commissioners may license any person to build or extend a wharf, construct a pier, dam, sea-wall, road, bridge or other structure, or fill land or flats in or over tide-water, below high-water mark and beyond the line of riparian ownership, upon such terms as they prescribe: *provided, however*, that no such license beyond the line of riparian ownership shall be valid unless approved by the governor and council; and *provided, further*, that no such license on any shore shall have any effect beyond such line of riparian ownership, except where a harbor line has been established by law along such shore; and no such license shall have effect beyond such harbor line, except in relation to a structure authorized by law outside such line.

SECT. 3. Every license granted under this act, or under the fourth section of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six, shall be signed by a majority of the commissioners, and shall set forth

the terms of the same, and specify by metes, bounds and otherwise, so as to identify and define, the location, dimensions, limits and mode of performing whatever is authorized by said license; and said commissioners shall cause a certified copy of the same, together with a correct plan of the authorized work or structure, to be recorded in books kept for that purpose in the office of said board. Before any license is granted, the board of harbor commissioners shall notify the selectmen of the town or the mayor and aldermen of the city, as the case may be, within the limits of which the work licensed is to be done, that they may appear and be heard.

SECT. 4. Licenses granted as herein provided shall be subject to the provisions of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six, and chapter four hundred and thirty-two of the acts of the year eighteen hundred and sixty-nine, so far as applicable and not inconsistent with this act; and every license hereafter granted by said board shall be void, unless the same and the accompanying plan are recorded within one year from the date thereof, in the registry of deeds for the county or district within which the work licensed is to be performed. But nothing contained in this act shall be construed to apply to the back bay lands.

SECT. 5. This act shall take effect upon its passage.
[*Approved April 23, 1872.*]

[Chapter 320, Acts of 1872.]

AN ACT IN RELATION TO THE IMPROVEMENT OF THE COMMONWEALTH'S
FLATS IN BOSTON HARBOR.

SECTION 1. The board of harbor commissioners, with the approval of the governor and a majority of the council, may contract for the construction, on a parcel of South Boston flats, situated at the junction of Fort Point Channel and the main channel, in Boston harbor, and adjoining the flats of the Boston Wharf Company and the flats sold by the Commonwealth to the Boston and Albany Railroad Company,—of sea-walls upon said channels, substantially on the lines shown on the plan for the occupation of the Commonwealth's flats in

South Boston, appended to the sixth annual report of said board to the legislature, and contract for the filling of said parcel within said walls with solid material; and said board of harbor commissioners shall have, in relation to said parcel, and the improvement of the same, all the powers conferred upon them by chapter three hundred and twenty-six of the acts of the year eighteen hundred and sixty-eight, and in addition may pay in cash for the improvement of said parcel, as authorized by law, and they shall be subject to all the provisions of said act not inconsistent herewith; and said board is further authorized to procure the discharge of all there may be on said parcel for taxes: *provided*, that all plans and contracts for the improvement of said parcel shall be subject to the approval of the governor and a majority of the council.

SECT. 2. The board of harbor commissioners may authorize, subject to the approval of the governor and a majority of the council, and to the provisions of section four of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six, and of chapter four hundred and thirty-two of the acts of the year eighteen hundred and sixty-nine, and on such other terms as may be considered just, the construction of wharves and docks at the junction of the main channel and Fort Point Channel, on the north-westerly side of the channel last named, within the outer general line of a scheme of wharves and docks shown on said plan, for the occupation of the Commonwealth's flats in South Boston, appended to the sixth annual report of said board, notwithstanding any existing harbor line heretofore established at said place.

SECT. 3. There shall be allowed and paid out of the treasury a sum not exceeding four hundred thousand dollars, to be expended for the purposes authorized in the first section of this act, and the same is hereby appropriated.

SECT. 4. From the net proceeds of the sales of all lands and flats contained in section one of the South Boston flats referred to in the fourth section of chapter three hundred and twenty-six of the acts of the year eighteen hundred and sixty-eight, all sums paid under this act, and all sums paid in the improvement of the same, with interest thereon, shall be first deducted, and the residue shall be paid into the sink-

ing funds established by chapter three hundred and thirteen of the acts of the year eighteen hundred and sixty-four, and chapter one hundred and twenty-two of the acts of the year eighteen hundred and sixty-five.

SECT. 5. For the purposes of this act, the treasurer and receiver-general may issue scrip or certificates of debt, in the name and on the behalf of the state and under his signature and the seal of the Commonwealth, to an amount not exceeding four hundred thousand dollars, for a term not less than five years, nor more than twenty years: *provided, however,* that scrip issued for a longer term than five years shall be redeemable at any time after the expiration of five years, at the option of the state. Said scrip or certificates of debt, shall be issued as registered bonds, or with interest coupons attached, and shall bear interest not exceeding six per cent., payable in the lawful money of the United States, semi-annually, on the first days of March and September of each year. Such scrip or certificates of debt shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, redeemable at the time specified, in the lawful money of the United States, and shall be sold and disposed of at public auction, or in such other mode, and at such times and in such prices and amounts, as the governor and a majority of the council shall deem for the best interest of the state.

SECT. 6. This act shall take effect upon its passage.
[*Approved May 4, 1872.*]

[Chapter 357, Acts of 1872.]

AN ACT TO AMEND AN ACT IN RELATION TO THE IMPROVEMENT OF THE
COMMONWEALTH'S FLATS IN BOSTON HARBOR.

SECTION 1. Section fifth of chapter three hundred and twenty of the acts of the present year, entitled An Act "in relation to the improvement of the Commonwealth's flats in Boston Harbor," is hereby amended by striking out the words "prices and amounts," and inserting the words "pieces and amounts."

SECT. 2. This act shall take effect upon its passage.
[*Approved May 7, 1872.*]

[Chapter 257, Acts of 1873.]

AN ACT IN RELATION TO THE IMPROVEMENT OF THE COMMONWEALTH'S
FLATS IN BOSTON HARBOR.

SECTION 1. The four hundred and forty-sixth chapter of the acts of the year eighteen hundred and sixty-nine is so far amended that the board of harbor commissioners may contract for or authorize the filling of any of the flats and lands purchased under the authority of said act, with any other material they think fit, besides that prescribed by the fourth section of chapter three hundred and twenty-six of the acts of the year eighteen hundred and sixty-eight: *provided*, that out of the proceeds of the sale of said flats and lands so purchased, there shall be paid into the compensation fund for Boston harbor, for tide-water displaced by filling with such other material, such sums as would be required by the provisions of the fourth section of the one hundred and forty-ninth chapter of the acts of the year eighteen hundred and sixty-six.

SECT. 2. This act shall take effect upon its passage.
[*Approved April 30, 1873.*]

[Chapter 284, Acts of 1874.]

AN ACT TO SECURE TO THE COMMONWEALTH THE VALUE OF ITS PROP-
ERTY IN LANDS FLOWED BY TIDE-WATER.

SECTION 1. Whenever any authority or license is hereafter granted by the legislature or by the board of harbor commissioners, with the approval of the governor and council, to any person or corporation to build any wharf or other structure or to fill or otherwise occupy land in tide-water lying below the line of low-water mark not exceeding one hundred rods from high-water mark, such person or corporation shall pay into the treasury of the Commonwealth, before the work authorized or licensed is begun, such compensation for the rights and privileges granted in such land as shall be determined by the governor and council to be just and equitable, besides making compensation for tide-water displaced when required under the one hundred and forty-ninth chapter of the acts of

the year eighteen hundred and sixty-six: *provided, however,* that when any such compensation shall have been paid for any such rights and privileges, the same shall not, under the provisions of the four hundred and thirty-second chapter of the acts of the year eighteen hundred and sixty-nine, terminate in five years and shall not be revocable unless provision is made in such revocation for the repayment by the Commonwealth to the holder of such rights and privileges, of the amount of such compensation.

SECT. 2. This act shall not apply to any authority granted to any city, town or county for the construction or widening or maintenance of a bridge constituting a part of a public highway.

SECT. 3. This act shall take effect upon its passage.
[*Approved May 29, 1874.*]

[Chapter 304, Acts of 1874.]

AN ACT TO PROVIDE FOR THE IMPROVEMENT OF BOSTON HARBOR AT JUNCTION SHOAL.

The board of harbor commissioners is authorized to contract for dredging off a portion of Junction shoal in Boston harbor, in the neighborhood of Constitution wharf, in such locality as said board shall designate, to a depth not exceeding twenty-three feet at mean low water, and said board may authorize the use of the material so dredged for filling the Commonwealth's flats at South Boston, at the junction of the main and Fort Point channels or elsewhere. The income from the compensation fund for Boston harbor received during the year eighteen hundred and seventy-four, and the receipts during such year from assessments for compensation for tide-water displaced which would otherwise be paid into the said compensation fund, shall be used to pay for such dredging to an amount not exceeding fifteen thousand dollars, which sum, derived from the sources aforesaid and no other, may be allowed and paid for such dredging, and the same is hereby appropriated. No such contract shall be made without the approval of the governor and council. [*Approved June 4, 1874.*]

[Chapter 347, Acts of 1874.]

AN ACT IN RELATION TO STRUCTURES IN TIDE-WATERS.

SECTION 1. The board of harbor commissioners is authorized and empowered to license any person to build or extend any wharf, construct any pier, dam, sea-wall, road, bridge or other structure, or to fill land or flats below high-water mark and beyond the line of riparian ownership in and over tide-water along the shore of which no commissioners' or harbor line has been established by law: *provided, however*, that no such license shall have any validity beyond the line of riparian ownership unless approved by the governor and council; and *provided, further*, that no such license shall be granted under the authority of this act for the construction of a bridge across any river, cove or inlet in any location not above the line of some existing bridge or other structure authorized by law over such tide-water in which there is in fact no draw and in which the law does not require that a draw be constructed or maintained or in case the mayor and aldermen of the city or the selectmen of the town within the limits of which the work licensed is to be done shall after the notice to them required by law appear and oppose the granting of the same. But the recital in such license that no such opposition has been made and the recital in any license of the said board that the notice required by law has been given shall be conclusive evidence of the facts recited.

SECT. 2. Every license granted under the authority of this act shall be subject to the provisions of the third and fourth sections of the two hundred and thirty-sixth chapter of the acts of the year eighteen hundred and seventy-two.

SECT. 3. This act shall take effect upon its passage.
[*Approved June 19, 1874.*]

[Chapter 399, Acts of 1874.]

AN ACT RELATIVE TO THE IMPROVEMENT OF THE NAVIGATION OF THE SOUTH BAY.

SECTION 1. The board of harbor commissioners is authorized to license any person or corporation to dredge out and otherwise excavate any portion of South Bay lying north-

westerly of the Boston, Hartford and Erie Railroad and outside of existing harbor lines as now established by law, and north-easterly of any extension of Swett Street hereafter made in an easterly direction, to a depth not exceeding twelve feet at mean low water within such limits, in such manner and to such extent as said board of harbor commissioners by such license shall determine and prescribe for the purpose of deepening and improving the navigation of South Bay.

SECT. 2. The attorney-general of the Commonwealth is directed on the request of the board of harbor commissioners to appear and prosecute or defend in any suit that may be brought to prevent or contest in any form the right to dredge out or excavate any portion of South Bay outside of the aforesaid lines and a license granted as herein before provided.

SECT. 3. Nothing contained in this act shall affect or take away the legal rights of any person or corporation. [*Approved June 30, 1874.*]

SEVENTH ANNUAL REPORT

OF THE

BOARD OF HARBOR COMMISSIONERS.

JANUARY, 1873.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
No. 19 PROVINCE STREET.
1873.

REPORT OF THE HARBOR COMMISSIONERS.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor Commissioners respectfully submit their Seventh Annual Report.

SOUTH BOSTON FLATS.

A small tract of the South Boston flats belonging to the Commonwealth, and comprising about twenty-five acres, situated at the junction of Fort Point Channel and the main channel of Boston Harbor, bounded on the north-east by the tract of fifty acres sold by the Commonwealth to the Boston and Albany Railroad Company, and on the south-west by the flats of the Boston Wharf Company, bears so important a relation to the execution of the scheme for the occupation of the State's extensive domain in tide-water on the South Boston shore, that the improvement of these twenty-five acres is essential to the proper initiation of this great project. In its last report the Board made the following statement: "It is absolutely essential to the interests of the State that the work on these twenty-five acres should be begun on some terms during the coming season. The occupation of this parcel, and the guarantee of the city of Boston, that when the land is made it shall be connected with the city, are all that is needed successfully to initiate a great public improvement that will bring some seven hundred and fifty acres of State flats into the market, as the growth of the city brings them into demand, and ultimately put millions of dollars into the treasury of the State.

The Board have, therefore, no hesitation in advising and urging that, if it is considered expedient to retain the control of this parcel of flats until the new Boston, Hartford and

Erie Railroad Company has been established, and even without any reference to the wants of this company, if no purchaser on favorable terms can be found to make the improvement, the State should enter upon the work with its own means, certainly to the extent of building the sea-wall and doing so much of the filling on the division lines between these flats and the adjoining flats of the other owners, as will obviate the necessity of building bulkheads on these lines to retain the filling. This done, all will be done, that is essential for coöperation by the State with its neighbors, and the question whether it had better complete the filling itself or not, can be decided hereafter."

In accordance with these views the legislature made an appropriation of \$400,000 towards the improvement of this parcel. The Boston Wharf Company was unwilling to bind itself to fill its adjoining tract without security that the land when made would be connected with the city proper by the extension over Fort Point Channel, of Eastern Avenue. It is very obvious, that if this company could not afford to improve its flats without this guarantee, still less could the Commonwealth, at the greater cost it incurs in so doing by reason of the obligation it has, out of regard to the public interest, imposed upon itself, to take the material for filling to grade 13 from Anchorage Shoal, in the upper harbor of Boston. Accordingly, after having obtained from the Boston Wharf Company its obligation to build its sea-wall on Fort Point Channel, and fill its flats and give the Commonwealth, for the purpose of filling the last three feet of its parcel with gravel, the necessary right of way over the company's territory,—an obligation, conditioned upon the execution by the city of an agreement to extend Eastern Avenue across Fort Point Channel,—the Board, on the 13th of May last, addressed to the city council of Boston the following memorial:—

To His Honor the Mayor and the City Council of the City of Boston.

Respectfully present the Board of Harbor Commissioners of the Commonwealth of Massachusetts the following memorial:—

The time has come when it is the desire of the Commonwealth immediately to begin the improvement of the South Boston flats.

The magnitude of this enterprise, and the important bearing it has upon the future development of the city of Boston, are made clear by the statement that it contemplates as an ultimate result, the addition to the city of a territory of between seven and eight hundred acres in extent, bordering upon the deep waters of the main channel of its harbor, the gain of some five hundred acres to the present somewhat contracted deep-water anchorage ground of the upper harbor, and the consequent enlargement of the facilities for the transaction of the business of a great and growing centre of manufactures and commerce.

The immediate measures by which it is proposed to begin this work, look to an early inclosure and filling of no less than a hundred acres of this territory. Fifty acres of it when filled will furnish the increased terminal facilities on deep water, which, in addition to those at East Boston, are so much needed by the Boston and Albany Railroad. The residue will supply like facilities to the Boston, Hartford and Erie Railroad, and to merchants the most advantageous sites for warehouses and stores.

For the purpose of securing a more harmonious movement of the tidal currents of the harbor, the plan of this improvement provides also for an extension of the wharves at the westerly junction of the Main and Fort Point channels to such limits as will give ample accommodation to the important business that is there concentrated, and more than restore to the shipping interest the dock-room that has been somewhat curtailed by the construction of Atlantic Avenue. The Commonwealth has already obtained the coöperation of the Boston and Albany Railroad Company and the Boston Wharf Company, and has only to receive assurance of such coöperation on the part of the city as will insure the connection of the land to be made with the city proper, to enter at once upon this work. The legislature at its last session authorized this Board to begin this improvement, and placed at its disposal, subject to the approval of the governor and council, four hundred thousand dollars, to be applied to the inclosure by a sea-wall and the filling of the Commonwealth's flats, at the easterly junction of the main and Fort Point channels. Previous to this appropriation, the Commonwealth had already expended a quarter of a million of dollars in buying up titles on the South Boston shore, under which claims were made that conflicted with the execution of this improvement, so vital to the business interests of the city of Boston.

While the Commonwealth undoubtedly had in view in prosecuting this enterprise, the possibility of making the value of its property in these flats available for the relief of all its citizens from the burdens of taxation, the controlling consideration that has held it

steadily to this work, has been the conviction that even if it yielded no profit to the treasury of the State, the great harbor improvement, the large accession of territory having a most advantageous location for business purposes, and the increased valuation Boston would gain by it, would justify the Commonwealth in undertaking it. When it is considered that the mere cost of the improvement of this first tract of a hundred acres which the Commonwealth desires at once to begin to occupy, will be two or three millions of dollars, it is obvious that the expense to the city of connecting this land with the city proper by two bridges over Fort Point Channel in extension of the projected Northern and Eastern Avenues, is insignificant in comparison with the capital which others have expended, and are still to expend, and the benefits to Boston that are to result from the work.

The plan of this improvement has received the sanction of the most eminent engineers in the country, and in its essential features, was devised by the United States Commissioners on Boston Harbor, appointed by the city itself. No question, therefore, can arise as to the beneficial effect, in a physical point of view, that the execution of this plan will have upon Boston Harbor.

In coöperating with the Commonwealth, the city of Boston will but contribute to the execution of its own designs, promote an enterprise it has long cherished, and help lay a new foundation for its own larger growth and increased prosperity.

This memorial was referred to a very able and intelligent joint special committee of the council, consisting of Messrs. John S. Clark, James Power and Leonard R. Cutter of the board of aldermen, and Wm. E. Perkins, Charles H. Hersey, Isaac H. Robbins, Wm. H. West and Horace Loring on the part of the common council. This committee was indefatigable in its investigations, and devoted a great deal of time mastering its details and perfecting a just basis of coöperation with the parties in interest. It obtained from the city engineer, Mr. N. H. Crafts, an estimate of the probable cost of extending Northern and Eastern Avenues over Fort Point Channel, so as to connect with the streets of the city proper, as follows :—

Eastern Avenue.

Solid portion, 66 feet wide, from Federal Street to Harbor Commissioners' line.

550 lineal feet of sea-wall, at \$103,	\$56,650 00
42,000 cubic yards of filling, at 65 cts.,	27,300 00
4,260 square yards stone block pavements, at \$3.50,	14,910 00
2,120 square yards brick sidewalk, at \$1.50,	3,180 00
1,736 lineal feet curbstone, at 85 cts.,	1,475 60
Total,	\$103,515 60
Add 10 per cent.,	10,351 56
Total,	\$113,867 16
57,288 square feet land, wharves and docks, at \$2.25,	128,898 00
	\$242,765 16

Bridge 60 feet wide with draw 50 feet wide; foundations and superstructures to be of wood.

24,000 square feet bridge, at \$3,	\$72,000 00
7,000 square feet draw, at \$5,	35,000 00
22,040 square feet draw-pier, at \$1.25,	27,550 00
800 lineal feet fender guard, at \$12,	9,600 00
	\$144,150 00
Add 40 per cent.,	14,415 00
	\$158,565 00
Cost of solid portion of avenue,	\$242,765 16
Cost of bridge structure,	158,565 00
Total estimated cost,	\$401,330 16

Estimate for Northern Avenue.

Solid portion, 75 feet wide from Broad Street to Harbor Commissioners' line.

160 lineal feet of sea-wall, at \$103,	\$16,480 08
9,300 cubic yards of filling, at 65 cts.,	6,045 00
1,245 square yards stone block pavement, at \$3.50,	4,357 50
600 square yards brick sidewalk, \$1.50,	900 00
434 lineal feet curbstone, 85 cts.,	368 90
	\$28,151 40
Add 10 per cent.,	2,815 14
	\$30,966 54
16,415 square feet land, wharves, and docks, at \$2.10,	34,471 50
Total,	\$65,438 04

Bridge 60 feet wide, with draw 50 feet wide ; foundations and superstructures to be of wood.

27,780 square feet bridge, at \$3,	\$83,340 00
7,000 square feet draw, \$5,	35,000 00
22,040 square feet draw-pier, \$1.25,	27,550 00
1,926 lineal feet fender-guard, at \$12,	11,112 00
	<hr/>
	\$157,002 00
Add 10 per cent.,	15,700 20
	<hr/>
Total,	\$172,702 20

Cost of solid portion of avenue,	\$65,438 04
Cost of bridge structure,	172,702 20
	<hr/>
	\$238,140 24

Summary.

Estimated cost of Eastern Avenue,	\$401,330 16
Estimated cost of Northern Avenue,	238,140 24
	<hr/>
Total,	\$639,4702 40

In their Report upon this memorial the Committee say :—

“ The project for the occupation of the South Boston flats, in the execution of which the Commonwealth invites the coöperation of the city, is one that was the subject of frequent discussion among the authorities of the city and its most sagacious citizens more than a generation ago, and has for several years had the shape of a definite, thoroughly matured plan, universally approved by the most eminent engineers of the country, studying merely the improvement of Boston Harbor, and the most intelligent men of affairs who studied the future growth and prosperity of Boston.

“ This project contemplates the inclosure by sea-walls and the filling up of from seven to eight hundred acres of flats that lie between Fort Point Channel and Castle Island in one direction, and in the other direction between the north-easterly shore of South Boston and the main channel of Boston Harbor. At low water, these flats are bare and unsightly, and taint the air with their offensive odors. The water on them is too shallow ever to make the present South Boston shore a valuable water-front, or this area serviceable as anchorage ground in Boston Harbor; when filled, however, to the border of the main channel, this whole territory will have a frontage on the deep waters of the harbor, and will afford that space in immediate

proximity to deep water which is so essential to the development of our commerce and manufactures. Boston has become what she is, primarily, by virtue of her frontage on deep water. She has now absolutely none that is conveniently accessible, which is not already occupied. This plan proposes an addition to the city of territory, with a water-front on the main channel, to which the approach will be unobstructed, as large as the whole of the original peninsula of Boston. There is no other unoccupied territory bordering on deep water so near to the present centre of business, available for the future growth of the city. Space it must have, and that space should possess the economical advantage which the harbor gives to the city; it should have that deep-water frontage by which the easiest and cheapest access is obtained to and from the whole world of commerce. Such a space can be found only on these South Boston flats. That such an additional space is now a pressing need of the city, as a commercial centre, no one can doubt who considers its extraordinary growth during the last few years, and the rapid increase of its foreign and domestic commerce. The South Boston flats bear the same relation to the demand for territory for manufactories, warehouses, and other business purposes, that the flats of the Back Bay have borne to the demand for house-lots. The Boston and Albany Railroad Company require, and will have, fifty of the first hundred acres of this improved territory, to enlarge its terminal facilities on deep water, and the present management of the Boston, Hartford and Erie Railroad desire to transfer its passenger station to this land on the south-easterly side of Fort Point Channel. When the relations of these railroads to the business of this community are considered, their needs must be regarded as the needs of the city of Boston.

“Nor will this large and much-needed accession of territory be the only gain. The Commonwealth, by the plan upon which this occupation is to take place, requires that the material used for filling shall, for the most part, be obtained by dredging out the upper harbor, so that it shall have a depth throughout of twenty-three feet at mean low water. The filling of the flats will be accompanied by an improvement of the harbor. The occupation of this territory upon such a basis will, it is estimated, enlarge the deep-water anchorage ground of the upper harbor by some five hundred acres.

“The harbor will also gain in another way. Opposite these flats is a large area of the harbor where the antagonistic forces of the ebb and flood tides being balanced, a neutral point in their scouring effects arises, and the result is a tendency in this locality to shoaling; when a sea-wall is built along the border of the main channel,

the ebb-tide will no longer be dispersed over the South Boston flats, but will be confined to the channel, and its power will be so augmented thereby as to give it a preponderance over the flood-tide all through the upper harbor, and overcome the tendency to an injurious accumulation of deposits at a place known as Anchorage Shoal.

“The plan also provides for an extension of the wharves on the westerly side of Fort Point Channel from Central Wharf to Foster’s Wharf inclusive. This will insure an enlargement of wharf accommodations to the extent of about half a million of square feet, or over ten acres, at a point where they have been much needed by the shipping interest, especially since the upper ends of the docks here were filled up in constructing Atlantic Avenue.

“The coöperation asked for by the State in this great undertaking, of such vital importance to the city of Boston, is simply that the city will obligate itself that when this improvement is so far advanced that about a hundred acres of these flats have been filled up to grade, it will connect this new land with the city proper by extending from it two avenues over Fort Point Channel; namely, Eastern Avenue, to the foot of Summer Street, and Northern Avenue, to the neighborhood of the foot of Oliver Street.

“The committee are unanimously of the opinion that it would simply be in the ordinary line of municipal duty for the city government to connect this territory, when made, with the city proper, by the avenues proposed, and that it is highly proper that the obligation to do so should be given. In no other way can this territory be made properly available for the business purposes for which it is so much needed, and it cannot be expected that capital will be invested in the occupation of the territory, without some security that when made, that connection with the city will be furnished, without which the improvement would hardly be worth undertaking. It has seemed to the committee that the only question to be determined was whether the amount of taxable property that would be created by the occupation of a hundred acres or thereabouts, which it is proposed at once to begin to improve, would be large enough to justify the city in engaging to incur the expense of extending these avenues as soon as the territory was filled to grade. * * * *

“We estimate the value of this made land for taxation, by adding the cost of filling and enclosure by sea-walls to the price at which these flats have been actually sold. About fifty acres of them were sold to the Boston, Hartford and Erie Railroad Company, at fifty cents, and fifty acres of them to the Boston and Albany Railroad Company, at twenty cents a square foot:—

Area of Commonwealth's Flats to be filled, 1,091,010 ft. at 50c.	\$545,505 00
of Boston Wharf Co.'s flats, . . . 1,147,094 " 50c.	573,547 00
of B. & A. R.R. Co.'s flats, . . . 2,178,000 " 20c.	435,600 00
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Total, 4,416,104 ft.	\$1,554,652 00
Cost of 1,700 feet of light wall at \$33 per running foot, . . .	\$56,100 00
of 2,178 feet of heavy wall at \$189 per running foot, . . .	411,642 00
of filling 4,416,104 feet at 40cts. per foot,	1,766,441 60
<hr/>	
	\$3,788,835 60
Deduct present assessed value of the flats now subject to taxation,	300,000 00
<hr/>	
	\$3,488,835 60

"We have, therefore, a property created by this improvement, amounting in round numbers to three and a half millions of dollars, which, assessed at the rate of .013 per cent., as the lowest rate of taxation, will yield an annual income to the city of \$45,000, an amount which would pay the interest at 6 per cent. on a principal sum of \$750,000. The utmost cost of extending these two avenues across Fort Point Channel by wooden bridges, and connecting them with the streets of the city proper, as estimated by Mr. Crafts, the City Engineer, on a liberal basis, is shown in the document annexed to this report, to be \$639,470.40.

"But besides the property thus created, it would be proper also to credit to this improvement the additional amount of wharf property which will be added to the city, between Central Wharf and Foster's Wharf, inclusive, as a consequence of the inclosure of the South Boston flats. The proprietors of Central and India Wharves are already petitioners for the right to extend their wharves, and such extensions will not only be admissible, but desirable, when the occupation has taken place on the opposite side of Fort Point Channel. The cost of extending these wharves is estimated by the Harbor Commissioners as follows:—

	<i>Filling.</i>		<i>Wall.</i>	
Central Wharf,	58,800 sq. ft. at 40c.,	\$23,520;	760 feet, \$100	\$76,000
India Wharf,	212,800 " at 40c.,	85,120;	1,800 " 100	180,000
Rowe's Wharf,	168,000 " at 40c.,	67,200;	2,370 " 100	237,000
Foster's Wharf,	25,000 " at 40c.,	10,000;	750 " 100	75,000
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Total area,	464,600 sq. ft.,	\$185,840;	5,680 feet.	\$568,000
Total cost of filling,				185,840
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Total cost of wharf extensions,				\$753,840

“These extensions will certainly be worth all that they cost.

“Besides, there are some thirty acres of made land belonging to the Boston Wharf Company, which would be so enhanced in value by the construction of these avenues that they would easily bear an advance of 25 per cent. in valuation for the purposes of taxation. This filled land is assessed on a valuation of \$1,080,000. The valuation could properly be raised after the extension of Eastern Avenue by at least \$250,000.

“Instead, then, of an increased valuation of \$3,488,835.60, the income from which alone would be more than enough to defray the interest on the cost of the work the city is called upon to do, it would be proper to reckon in addition \$753,840 for the wharf extensions, and \$250,000 for the increased valuation of the existing land of the Boston Wharf Company.

“These additions would raise the increased valuation to about $4\frac{1}{2}$ millions of dollars, which at the same rate of assessment (.013 per cent.), would yield to the city annually in taxes \$58,500, a sum which would pay an annual interest on \$975,700 : while the cost of the proposed extensions of Northern and Eastern Avenues would be but \$639,470.40.

“We have estimated the value of the land merely. But it is to be remembered that this land will be occupied by warehouses, elevators, manufactories and other structures, which will yield still further increase of revenue to the city.

“It is unnecessary to enlarge upon the convenience of having these additional avenues to South Boston and the city institutions there established ; for with the progress of this improvement, it is obvious that these avenues will be continued to meet the extension of the streets running out from South Boston shore, and will greatly improve the means of communication between the city proper and South Boston.

“There is an additional reason why the city should coöperate with the Commonwealth in this improvement, which would not exist were the coöperation of the city sought in behalf of a private interest. Whatever profit the State derives from these improvements or the sale of its flats, is pledged to pay off the war loan of the State, by chapter 313 of the Acts of the year 1864. and chapter 122 of the Acts of the year 1865 (see also chap. 320, Statutes 1872). The city of Boston pays one-third of the tax of the Commonwealth, and must pay one-third of this loan, if paid by taxation. To the extent of one-third of the amount that the loan is paid from the proceeds of the sales of these flats or the profits of this improvement, the city of Boston is relieved from taxation. The city is

thus a partner to the extent of a third interest in all the profits of the Commonwealth shall secure to its treasury from these flats.

“The case, then, in brief is this: The State is engaged in a work that will greatly improve Boston Harbor and promote the business interests of the city. The city is asked to coöperate to the extent of obligating itself to do at a given time what it recognizes it must ultimately do in the discharge of the municipal duty of maintaining highways, when needed, over navigable waters within its borders. The income of the city will be increased by the improvement beyond the cost of the work it is asked to agree to do. It will in effect share the pecuniary profit to the State to the extent of one-third of all that is made, besides receiving the whole of the direct advantages to be derived from its improved harbor and business facilities. A stronger case could hardly be made out.”

The Committee accordingly reported an order that the mayor execute, in behalf of the city, an indenture of four parts between the Commonwealth of Massachusetts, the Boston and Albany Railroad Company, the Boston Wharf Company and the city of Boston, obligating to the city of Boston, the other parties to improve their respective parcels of flats, and convey to the city without expense the fee of the projected streets when filled to grade within the limits of such parcels, and obligating the city to these other parties to extend Northern and Eastern Avenues across Fort Point Channel to some existing street of the city proper, at an expense for both, not exceeding the estimate of the city engineer. In the course of the passage of this order opposition arose on the grounds that no provision was made that the other parties should share with the city of Boston the expense of constructing these extensions of Northern and Eastern Avenues, that the indenture should provide that other streets should be made and laid out, without expense to the city, on other portions of the South Boston flats, outside the limits of the hundred acres to be first filled, and that the fee of these streets, when made, should be vested in the city.

It was also claimed that the Commonwealth should engage to build streets in advance of the filling of its territory, for the purpose of giving new avenues of communication between Boston proper and South Boston, particularly by way of Mt. Washington and Eastern Avenues.

To ascertain what could be accomplished in these directions, the city council recommitted the subject to the committee with instructions to make the necessary inquiries.

Accordingly the committee addressed communications to the Boston and Albany Railroad Company, the Boston Wharf Company and this Board, to obtain the views of the parties upon these points. Their respective answers were as follows :—

COMMONWEALTH OF MASSACHUSETTS.

HARBOR COMMISSIONERS' OFFICE, BOSTON, Oct. 7, 1872.

TO JOHN T. CLARK, ESQ., *Chairman of the Joint Special Committee of the City Council on the occupation of the South Boston Flats.*

DEAR SIR :—The Board of Harbor Commissioners has received the communication of your committee inquiring as follows: 1. Whether the Commonwealth, acting by this Board, will pay the city in flats its proportion of an assessment for betterment to its lands and flats on the northerly shore of South Boston, laid in accordance with the principles of the betterment law, on account of the construction of the bridges and the approaches thereto across Fort Point Channel, and the reserved channel, as shown on a plan accompanying the sixth annual report of this Board. 2. Whether the Commonwealth will convey to the city, land filled to grade sixteen for such streets and avenues as the city may lay out over territory belonging to the Commonwealth on the northerly shore of South Boston. The committee also express the opinion that such an agreement would materially assist in procuring the passage of the order authorizing the signature of the indenture for the construction of the bridges by the city.

The Board are exceedingly desirous that the committee should appreciate the considerations that govern the Board in answering these inquiries. The proposition made to the city by the Board in its memorial was in substance that the city should coöperate with the Commonwealth in its measures for securing a great improvement of the harbor of Boston, which could not but be of immense benefit to the city. This improvement was to be made by building a sea-wall on the easterly side of Fort Point Channel, and along the southerly border of the main channel, at first down to Slate Ledge, and ultimately to Castle Island, and dredging out the upper harbor. The sea-wall would overcome an injurious tendency to shoaling at a locality in the upper harbor known as Anchorage Shoal, about two hundred acres in extent, where the water at low tide has an average depth of not more than twelve feet, by concentrating in the main

channel, and making more effective the ebb-tide, whose force is now weakened by diffusion over the whole area of the South Boston flats. The construction of this sea-wall as an independent work for the improvement of the harbor, without any reference to the occupation of the flats behind the wall, was recommended to the city by its United States Commissioners. (See Tenth Report of U. S. Commissioners, pp. 76–84, and 87–92, City Doc. No. 50, 1866.)

The plan of the improvement further contemplates the extension of wharves on the Boston side of Fort Point Channel at the outlet, and the dredging out here of a new channel in such a manner that the ebb current, on leaving the outlet, will be made to move in the same, instead, as now, of the opposite direction to that of the current of the main channel. The dredging to be done in the course of this improvement will first effect the removal of Anchorage Shoal, and ultimately add five hundred acres to the deep-water anchorage in the upper harbor, for vessels of the first class. The material dredged is to be used in filling the Commonwealth's flats behind the sea-wall to thirteen feet of the grade of sixteen feet to which the territory is to be raised. Unless, however, two of the streets of the city proper are to be extended over Fort Point Channel, the territory to be made in the process of improving the harbor would not probably pay the cost of the harbor improvement, and the Commonwealth would not be willing to undertake it. The form of an indenture to which the city is asked to become a party provides that twenty-five acres of the Boston Wharf Company, fifty acres of the Boston and Albany Railroad Company, and twenty-five acres of the Commonwealth, in all one hundred acres, shall be inclosed by a sea-wall and filled as the first instalment of the harbor improvement, and the beginning of the occupation of a tract of flats here some eight hundred acres in area, and the city is asked to extend to this territory over the intervening channel two of its streets, when the hundred acres are filled.

The city is not asked so to agree unless it believes that it is for the public interest of Boston that such an extension of its streets should be made, and that it can be properly done when a hundred acres are inclosed and filled. That it is for the interest of the city to make this extension of its streets is made clear by the following considerations :—

1. Because in so doing it gains this harbor improvement. The filling of these hundred acres will secure the removal of Anchorage Shoal from a valuable part of the harbor, and a depth of water twenty-three feet at mean low tide over some two hundred acres where the depth is now on an average but about twelve feet. And yet this is but a beginning of the enlargement of the deep-water area of

the harbor where an ocean steamer can float at low tide, and of the water-front on the main channel accessible to the same class of vessels.

2. The Boston and Albany Railroad Company, the main line of railroad communication from the West, will have on this territory another freight yard that will give to Boston a much-needed increase of its facilities for foreign shipment of Western products, and make good a deficiency that, during the past year, became painfully apparent to the business community. The proposed extension of streets will give the necessary means of access to this new centre for the distribution of freight that will have relations with all the business interests of the city.

3. This whole territory of the South Boston flats, some eight hundred acres in extent, will be annexed to the business portion of the city by the proposed bridges, and this is the only unoccupied territory, with an unobstructed frontage on deep water, available for the future growth of the business of the city. Experience has shown that the growth of the business of the city has been limited only by the facilities for transacting it.

4. The cost of these bridges will be speedily reimbursed to the city by the amount of taxable property created in the progress of the harbor improvement. Property on Broad Street, nine hundred feet from the border of these hundred acres, is assessed at five dollars per square foot. If this area, when filled and connected with the city, is estimated to be worth a dollar and a quarter a foot upon an average, it will be worth \$5,445,000, which, as a basis of assessment at thirteen dollars on a thousand, would yield \$70,785 per annum.

The cost of the bridges is estimated by the city engineer, in round numbers, at \$640,000; the interest on which, at six per cent., would be \$38,400. The income from the property above the interest on the cost of the bridges would consequently be \$32,385,—an amount which, if paid into a sinking fund, would in fourteen years reimburse the whole outlay. No account is made in this estimate of the increased value to be given to the adjoining thirty acres of filled land belonging to the Boston Wharf Company, or to the value of the wharf extensions to be made on the Boston side, or to the buildings to be erected on this new land, or to the fact that the estimate is based only on the one hundred of the eight hundred acres to be ultimately improved and incorporated by these bridges as a part of the business portion of the city. The cost of maintaining these new bridges will be insignificant for at least ten years, and the city need incur no other expense upon the territory itself before it has been so far built upon that the city can afford to assume the maintenance of

the streets and other expenses incident to a full municipal jurisdiction.

The statement has been made that only twenty-five of the hundred acres are subject to taxation, because the title to the residue is in the Commonwealth, and so exempt from assessment. But as soon as the fifty acres of the Boston and Albany Railroad Company are filled, the State is bound by contract to convey the territory to the company, and will do so. When the twenty-five acres of the State are filled, they will be sold and be relieved from any present exemption. It has also been said that other bridges will be required over the reserved channel, and that this is but the beginning of similar expenditures that will be required of the city to make connections with this territory. The Board, however, do not regard this reserved channel as necessarily a permanent feature in the plan of improvement. It has been abandoned so far as E Street already, and as a better water-front shall be secured on the main channel, the Board is of the opinion that the shore owners will find it for their interest to improve their flats and get their water-front upon the new and better line.

However this may be, the Board cannot see how another bridge, beside the two proposed, can be required under any circumstances before the residue of the first section of the South Boston flats, amounting to about two hundred acres, has been filled. One short bridge on the extension of L Street might become desirable, if the shore owners should not wish to improve their flats.

5. Whatever profit is obtained from the sale of land made is pledged to pay the war debt of the Commonwealth. The amount of this profit lessens so much the amount to be raised by taxation, and as Boston pays one-third of the taxes of the State, it has a third interest in this profit.

The case, then, is this: The Commonwealth proposes to make a harbor improvement of the greatest public value to the city of Boston, and asks the city to agree to make such an extension of its streets to the land created in the process of making this improvement as the public interest of the city requires should be made, and without which the State could not afford to make the improvement. It is asked to make this extension of its streets with the knowledge that the land to which the streets are extended will, when made, yield in taxes enough to reimburse the city in a few years its whole outlay, and that it will share in common with the rest of the Commonwealth whatever profit is made by the State from the sale of the land. Upon this state of facts it is proposed that the city will extend its streets over Fort Point Channel, if the Commonwealth will agree to pay the city for the benefit to the lands and flats of the Commonwealth

caused by this extension to them of the city's streets, what would be assessed under the betterment law. But why should the city ask the Commonwealth to pay the whole or part of the cost of the extension of its streets, on account of the incidental benefit to the land of the Commonwealth, when the Commonwealth is making this land merely in the process of making a great harbor-improvement, which is immensely to benefit the city of Boston? If the city is to make claims on account of the benefit it will confer upon the Commonwealth, how can it refuse to take into account the benefit the Commonwealth is to confer upon the city of Boston? By any test, it will appear that the benefit conferred upon the city is greater than that conferred by the city, even if estimated at the whole cost of the proposed extension of its streets. Compare the cost of the harbor improvement with the cost of the street extensions. The cost of the sea-wall for these hundred acres will be \$467,742. This wall is of itself a harbor improvement, as already stated. The dredging from Anchorage Shoal and Fort Point Channel of material that must be used in filling these hundred acres, will amount to 1,743,000 cubic yards and will cost, at forty cents per cubic yard (the usual estimate), \$697,200, and add to Boston Harbor two hundred acres of water, twenty-three feet deep at mean low tide, and thereby increase by over one hundred per cent. the deep-water anchorage of the upper harbor.

The cost, then, of the harbor improvement that is incidental to the making of these hundred acres of land will be \$1,164,942, an expenditure made solely to improve the commercial facilities of the city of Boston; for the State has never entertained the idea of filling these flats except as a part of a harbor improvement. The cost of the street extensions will be \$640,000, as estimated by the city engineer. And yet this is but the beginning of the harbor improvement which the State has undertaken. The whole of the sea-wall to State Ledge will cost \$857,460. To fill the flats to the same point will insure the dredging from the main channel of at least five and a half million cubic yards of material, at a cost of \$2,200,000,—making the cost of the harbor improvement for the first section of the flats over three million dollars; and yet this first section covers but a third of the territory ultimately to be filled. The cost of the sea-wall alone to Castle Island will be \$2,024,535, and every foot of this wall will improve Boston Harbor.

The cost of the harbor improvement for the hundred acres is nearly double; its cost for the first section of South Boston flats five times, the amount of the expenditure the city will incur in extending its streets. When Boston will receive the exclusive benefit of this vast expenditure directly in its improved harbor, with what reason can it

be claimed that the people of Massachusetts should build, at their expense, or pay for the extension of the city's streets to territory made by the Commonwealth along a line of deep-water frontage to which the people of Boston must have access? The Board can see no justice in the claim, and cannot assent to it. It is of the opinion that when the Commonwealth bestows upon Boston this great public improvement, without any cost to the city, it is not required in addition to build or help build streets for the city, which shall enable it to secure for itself the full benefit of the improvement thus gratuitously bestowed.

To the second inquiry, "Whether the Commonwealth will convey to the city land filled to grade 16 for such streets and avenues as the city may lay out over the territory belonging to the Commonwealth on the northerly shore of South Boston?" the Board desire to answer that it has cheerfully acceded to all the suggestions of your committee relating to the conveyance to the city, without charge, of land filled to grade 16 for such streets and avenues as the city wished to lay out within the limits to which the territory shall at the time be filled, and it cannot imagine a proposal of this sort which the city would be likely to make that would not readily be accepted. It is also willing to agree that either B or C Street, as it may elect, shall be extended to Eastern Avenue within one year after the filling of the hundred acres has been completed. This would give a new avenue of communication between South Boston and the city proper. It would be for the interest of the Commonwealth to fill the space between the south-westerly line of the territory of the Boston and Albany Railroad Company and First Street, as soon as the company's flats are filled, and this street would be made in the progress and as a part of this filling. To a proposition, however, to engage in a project for building streets in advance of the filling of the adjoining territory, merely for the purpose of giving new avenues of communication between Boston proper and South Boston, the Board would feel it had no right to assent. Such action it would regard as an improper appropriation of the property of the State to the uses of the city.

In conclusion, it should be said that the Board appreciates the responsibility it assumes in giving these answers to the inquiries made by your committee. Its deep interest in Boston Harbor makes it very desirous of entering upon the work of improving it, and for the sake of obtaining the indispensable coöperation of the city, it has been willing to concede all that has been asked, except what under the trust confided to it by the Commonwealth, it has seen it had no right to yield.

Very respectfully yours,

JOSIAH QUINCY,

Chairman of the Board of Harbor Commissioners.

REPLY OF BOSTON AND ALBANY RAILROAD COMPANY.

BOSTON, MASS., October 7, 1872.

To the Joint Special Committee on subject of occupation of South Boston Flats.

GENTLEMEN :—In reply to the inquiry put to me by Mr. Bugbee, the clerk of your committee, I have to say that this company have an interest in fifty acres of flats at South Boston, for which the price to be paid is about \$435,000, and that, by any scheme which has yet been presented, it will cost more than a million of dollars to connect those flats with our yard and tracks in Boston proper by an independent bridge and track.

By the terms of the Act of the legislature we are compelled to cross certain streets of the city, either over or under them, thereby adding very largely to the cost of this connection. The company is also expected to be at the sole expense of filling the avenues and streets which pass over their territory. By the contract with the State, the railroad company is also required to dredge the chief part of the material for filling this tract of fifty acres from the harbor, at a cost probably double what it would be to haul gravel for the purpose over the railroad, thus making a very large contribution toward the permanent improvement of the channel and harbor of Boston.

The railroad bridge and tracks will, in my judgment, contribute quite as much to the development of property in South Boston and in the city proper as the other bridge.

If an arrangement can be made by which the railroad company can use the bridges to be built by the city with their trains, the case would be presented in a different light. As it is, I cannot but think that the Boston and Albany Railroad Company will be required to bear their full proportion of the cost of this South Boston enterprise without making any contribution or being assessed for any betterment on account of the construction of the bridge, and the approaches across Fort Point Channel and the reserved channel.

I may add that during the negotiation with the Harbor Commissioners and the governor and council, which resulted in the contract between the State and the railroad company, it was always represented and understood that these bridges were to be built by the city. I do not know by what authority, but such is the fact, and our contract was made with that expectation and understanding.

I have the honor to be, very respectfully yours,

D. WALDO LINCOLN. *Vice-President.*

REPLY OF BOSTON WHARF COMPANY.

BOSTON, October 15, 1872.

JOHN T. CLARK, Esq., *Chairman of the Joint Special Committee on the occupation of the Flats on the northerly shore of South Boston.*

SIR:—The standing committee of the Boston Wharf Company, in May last, made a contract with the Commonwealth, the performance of which would involve the spending of a large sum of money, and the giving up of a large amount of land; and that contract, which was the result of long and careful consideration by the Harbor Commissioners, and this company, we are still willing to carry out.

At the time of making that contract, the company did not suppose that in addition to what they were then agreeing to do, a payment of an assessment for betterments could be asked of them, and certainly they would not have agreed to any contract containing such a provision. It would be most unjust to subject them to it, when they have bound themselves to surrender for public use, without payment, many thousand feet of valuable lands filled up and graded at a great expense, and also to expend large sums of money, without immediate or special benefit to themselves, but chiefly to facilitate the speedy completion of the improvements proposed by the State and city.

In reply to the communication of your committee, therefore, the Boston Wharf Company can only say that they are still ready to perform their contract, and to do their full share in the great project of improving the flats at South Boston; but they cannot agree to contribute further toward the expense of constructing the bridges by which it is proposed to connect them with the city proper.

Yours, very respectfully,

J. D. FARNSWORTH,

Treasurer of the Boston Wharf Company.

The committee reported a new form of an indenture, providing, in addition to the one first reported, that the city might lay out Northern Avenue one hundred feet instead of seventy-five feet wide, and Eastern Avenue seventy-five feet instead of sixty-six feet wide; that the Commonwealth and the Boston Wharf Company should, without charge, convey to the city when filled to grade, the extension of Mt. Washington Avenue to the westerly line of E Street, the extension of C, D, E, F and K Streets to Eastern Avenue, the extension of L Street to Northern Avenue, and the extension of Northern

Avenue and Eastern Avenue to L Street, and that within one year after the Boston and Albany Railroad Company had filled its territory the Commonwealth should fill and convey to the city, without charge, the extension of either B or C Street to Eastern Avenue as this Board should elect, so that upon the construction of the Eastern Avenue Bridge a new avenue of communication should be opened between South Boston and the city proper.

In its able report the committee discusses at considerable length the expediency of the city's coöperation upon these terms, and the objections that had been made to such coöperation in the following manner :—

“ Neither of the other parties to the contract will consent to pay any portion of the expense of constructing these bridges for reasons which are presented very fully in the several communications appended hereto. It is evident, from the several conferences which your committee has had with those parties, that the improvement will not be commenced for a considerable time, if at all, unless the city will coöperate to the extent designated in the indenture.

* * * * *

“ While there may be differences of opinion in regard to the relative obligations of the parties interested in carrying out this improvement, there can be but one feeling as to the importance of securing early action. Indeed, the value which such action would have in promoting the commercial prosperity of the city can hardly be overestimated. The simple question to be decided by the city government, as representing the interests of all the citizens, is the extent to which the city, in its corporate capacity, would be justified in aiding and encouraging this work. The duties of municipal governments in furnishing facilities for public travel and the transaction of business have been very much enlarged since the days when bridges and turnpikes were owned by private corporations, and tolls were collected for their use. Experience has shown that it is a very short-sighted policy to leave matters which so nearly concern the public safety, convenience and prosperity under the control of private parties. The result of allowing owners of land to build streets and bridges in their own way, with a view solely to the improvement of their property for the time being, is seen in the enormous expenditures from the public treasury for widening, straightening and extending streets, and building permanent bridges in place of temporary structures. It has been found far more economical for the city to buy the land for streets while it is cheap, and

have it laid out in a manner to meet the future requirements of public travel and business, than to leave it in the hands of private parties, having separate interests, and intent only on securing a present advantage. It will be remembered that the last legislature, upon the petition of the city council, authorized the city to purchase land and lay out streets in Dorchester and Roxbury in advance of the occupation of the territory. The committee on streets and the street commissioners are now engaged in preparing plans for laying out this territory in a manner suited to its future needs. Last year the city entered into an agreement with Mr. Munson, in which it obligated itself to pay \$300,000 for filling certain streets on the Back Bay, and also to build suitable iron bridges over the railroad tracks, and *not to assess any betterment on the land abutting on the streets and bridges*. Two of the bridges provided for under that agreement have just been constructed, at an expense of about \$200,000. Although the city may have agreed to do more in that case than the general interests required, the principles upon which the agreement was founded, namely, the immediate development of the property for purposes of taxation, and the establishment of suitable streets and bridges for the public safety and convenience, were undoubtedly sound.

“So far then from the proposed action in the case of the South Boston flats being unprecedented, it is strictly in accordance with the recent policy of the city,—a policy which, if intelligently pursued, is calculated to develop our resources to the fullest extent and in the most economical manner. A statement of the direct benefits which the city will receive from the performance of this work shows clearly that it is not asked to lend its aid to an extent beyond its interests.

“In addition to what has been said by the Harbor Commissioners in regard to the value of this work as a harbor improvement, we quote the following extracts from a communication submitted in 1866 by Rear-Admiral Davis, Gen. Delafield (late Chief of the Engineer Corps, U. S. A.), and Prof. Mitchell (of the U. S. Coast Survey), in reply to the question whether the occupation of the flats, or a portion of them, on the northerly shore of South Boston, was ‘so important to the improvement of the harbor of Boston that it ought to be carried out by the city of Boston, even if the sales of property created were not likely to remunerate the expenses of the work.’

“‘The occupation of South Boston flats, at first suggested in early reports, gained importance in the minds of the U. S. Commissioners as their hydrographic and physical survey advanced; and finally the Com-

mission has recommended the occupation of the flats for commercial and other industrial purposes, provided a quay-wall be first constructed along its channel side, the main ship channel dredged abreast of this quay, and a reservoir created above the city as a receptacle for as much water, or an equivalent, to keep open the ship channel above and below the city, as well as along its wharves.

“ ‘ We may reiterate that our views and purposes have invariably been to attain the general benefit of the community in all that affects its prosperity, growing out of its local advantages for commerce and trade, and in looking forward to the increase of maritime interests, as well as the existing conditions connected with it.

“ ‘ In further answer to your question we must remark that, in view of the present connection of the city of Boston by rail with the northern and western lakes, thence from the shores of Lake Michigan by numerous railroads to the Mississippi, and still westward by existing railroads far extended to the dividing ridge between the head-waters of the Missouri and the Pacific, with the manufacturing, agricultural, mining and commercial interests between Boston and these Western regions; and the immense and rapid increase of population to interchange their industrial labors,—we consider that no reasonable sum the present population of this city can afford can exceed the direct and future benefits to arise from improving the harbor, and securing its increased capacity, which cannot be overestimated in producing a lasting benefit to its inhabitants, independent of any reasonable sum it may cost to effect the object, over and above the amount of sales of property to be reclaimed from the submerged flats.’* ”

“ So important is this harbor improvement to the future commercial prosperity of the city that it would clearly be the duty of the city government to secure it by the building of these bridges, if there were no other considerations whatever. But it can be shown conclusively that, apart from the harbor improvement, the city would be justified in entering into this agreement. The other parties to it are obligated to fill one hundred acres of flats, mainly with material dredged from the harbor, and build a substantial sea-wall to inclose it on Fort Point Channel, and the main channel, within three years from the first of October of the present year. When this is done the occupation of the other flats on the northerly shore of South Boston, covering an area of about seven hundred acres more, and extending to Castle Island, will speedily follow.

“ The income which these hundred acres would furnish in taxes to the city, on the basis of one dollar and twenty-five cents a square foot, would amount to \$70,785 per annum; while the interest on the highest estimated cost of the bridges would, at six per cent., be

* “This opinion was given, by the distinguished gentlemen named, in 1866. The importance of this improvement, from a commercial point of view, has greatly increased since that time.”

only \$37,400. The excess of income from taxation over the interest on the loan for the bridges would establish a sinking fund sufficient to reimburse the whole outlay in fourteen years. At the present time the city gets nothing in the way of taxes from seventy-five acres of these flats (that is, the twenty-five acres standing in the name of the Commonwealth, and the fifty acres in the name of the Boston and Albany Railroad Company), and until they are filled and made available for business purposes, by connection with streets on the westerly side of Fort Point Channel, the State will continue to hold them, and thereby exempt them from taxation. A provision has been inserted in the indenture, that the city shall not be required to build the bridge in extension of Northern Avenue until the State conveys the fifty acres of flats shown on the plan to the Boston and Albany Railroad Company.

“In the foregoing estimate of the income from property to be made immediately available under this agreement for taxation, no account has been made of the increased value of adjoining property belonging to the Boston Wharf Company, and to the riparian proprietors on the South Boston shore; or of the wharf extensions to be made on the Boston side, to the extent of 731,900 square feet.

“In the indenture for the occupation of the Back Bay lands, the city, in consideration of having the property made available for taxation within a certain time, agreed to pay for the building of streets as well as the bridges. In this case, the other parties to the indenture agree to build all the streets which it would be reasonable to require for the public convenience, and convey them to the city without expense. It should be understood that the building of these streets on the South Boston shore is far more expensive than those on the Back Bay. The area to be conveyed to the city for streets and avenues, under this indenture (exclusive of the limits outside of these hundred acres), covers 561,025 square feet.

“It has been stated that there has been no legislation which contemplates that the city of Boston is to aid in the development of this territory without compensation in flats by the Commonwealth. The inference which it is intended shall be drawn from this statement is, that the legislature has all along contemplated paying the city for the construction of bridges and streets to and over this territory. It is only necessary to look at the language of the several statutes in relation to the improvement of this territory, to show that the legislature had no such intention.

“By chapter 81 of the Resolves of 1866 (which has become obsolete by subsequent legislation), the Harbor Commissioners, subject to the approval of the governor and council, are authorized to contract with the city of Boston for the building of the whole or any

part of Eastern Avenue, and to make payment in flats northerly of the South Boston shore, '*provided, that compensation for all tide-water excluded by carrying into effect these shall be duly made as provided in the Act to establish a Board of Harbor Commissioners.*' Under the proposed agreement, Eastern Avenue is to be built and conveyed to the city, without expense for land or grade damages, and without any assessment on account of tide-water displaced.

"By chapter 93 of the Resolves of 1867, a joint committee of the legislature was authorized to contract with any person or persons, or with the city of Boston, for filling any portion of said flats, or for building wharves, making docks, basins, streets, bridges, or sewers, dredging, or doing any other work upon or in relation to said flats, and to pay for the same by conveyances of any portion of said flats, or by grant of any rights or privileges therein. It is not to be supposed for a moment that the legislature intended that the committee should contract for doing each one of these things separately, and pay in flats. The whole work of dredging, making docks and basins, and building wharves, is to be taken in connection with the authority to pay in flats.

"By chapter 326 of the Acts of 1868, the authority to contract for doing this work was given to the Harbor Commissioners, subject to the approval of the governor and council; and by the sixth section of that Act, the city of Boston was authorized to build and lay out as a public street, Eastern Avenue, with a bridge over Fort Point Channel, having suitable draws, said avenue and bridge to be located and constructed at such places, and upon such plans, and upon such terms and conditions, as the Harbor Commissioners might make, subject to the approval of the governor and council.

"In the opinion of the Harbor Commissioners it would not be a proper discharge of the trust reposed in them by the legislature, to contract to pay the city, either in flats or money, the whole or any portion of the expense of building these bridges; and it is believed that their views as to the obligations of the parties interested in this improvement are sustained by the governor.

"In reply to the suggestion that the city should extend Eastern Avenue and other streets, to connect with the present streets in South Boston in advance of the filling, it may be stated that the independent construction of highways over the flats would be attended with enormous expense, on account of the walls necessary to retain the filling. As the State obligates itself, in the accompanying indenture, to build these streets as soon as the adjoining flats are filled, and convey them to the city without a dollar of expense for land or grade damages, it would be an unnecessary expenditure of money to build the streets now. Such action would,

moreover, involve the construction of bridges over the space marked on the plan for a reserved channel, when it is doubtful whether there will be any channel reserved. (See statement of Harbor Commissioners.)

“Believing, as we have already stated, that the terms upon which the city is asked to coöperate in this work are the best that can be obtained, and that it is greatly for the interests of the city to enter into an agreement by which the immediate performance of this public improvement is secured, the committee would respectfully recommend the passage of the accompanying order.

“JOHN T. CLARK,
JAMES POWER,
LEONARD R. CUTTER,
WM. E. PERKINS,
CHARLES H. HERSEY,
ISAAC H. ROBBINS,
WM. H. WEST,
HORACE LORING,
Committee.”

The order for the execution, by the mayor in behalf of the city, of the indenture of four parts finally reported by the committee, passed the board of aldermen by a unanimous vote and the common council with but three dissenting votes, and took effect on the 11th day of November last. The indenture was forthwith executed by the Harbor Commissioners in behalf of the Commonwealth, subject to approval by the governor and council, and by the Boston Wharf Company; and His Honor, Mayor Gaston, was ready to execute it. When submitted for execution to the Boston and Albany Railroad Company, and carefully examined, an apprehension was expressed, that the provision obligating the parties owning the flats to convey the fee of the streets to the city might be held to amount to a waiver of the right granted the company by chapter 461, section 4 of the Acts of the year 1869, to lay its tracks across and along portions of the streets to be laid out under the indenture over the flats it had purchased of the State, to obtain access across the line of these projected streets to deep water. It was believed that by a conveyance of the fee of the streets, it would surrender its right as owner of the soil, and possibly its right under the statute to lay its tracks across and along these streets.

The negotiations for adjusting this difficulty continued till the close of the municipal year. The Board could not ask the city to go to the expense of building expensive bridges while a railroad company reserved to itself the legal right to obstruct avenues which terminated in these bridges so completely with its freight tracks as to make the avenues unsuitable to be highways for public travel beyond the limits of the company's grounds. Moreover, the reservation of such an unlimited right to obstruct highways could not but affect injuriously the Commonwealth's flats lying beyond the track of the railroad company. The Board hope that this conflict of interests may be adjusted without recourse to further legislation. The board of directors of the company on the 2d day of January of the current year adopted the following preamble and vote :—

“ *Whereas*, This Board is unwilling to part with any rights which have been granted to the corporation by chapter 461 of the acts of the year 1869, which are deemed essential to a beneficial use of the property purchased under authority of said act; and *whereas*, we desire to coöperate with all parties in interest for the early development of the property.

“ *Voted*, That the whole subject be referred to the finance committee, with Messrs. Lincoln, Crocker and Gillett added, with authority to make such contracts in relation thereto as they may deem expedient.”

His Honor Henry L. Pierce, mayor of the city of Boston, in his inaugural address to the city council for the coming municipal year, used the following language in relation to this subject :—

“ A good deal of time was expended by the last city government in adjusting a comprehensive plan for uniting the Commonwealth, the Boston and Albany Railroad Company, the Boston Wharf Company and the city of Boston in the work, already too long delayed, of improving the South Boston flats. The occupation of these flats is incidental to a great harbor improvement which the Commonwealth has undertaken, the first installment of which will secure the removal of Anchorage Shoal, and add some two hundred acres to the deep water of the upper harbor of Boston.

“In view also of the uses to which this territory is to be put as terminal grounds at deep water of the Boston and Albany Railroad Company, and without doubt of the new Boston, Hartford and Erie Railroad Company, soon to be organized, it cannot fail to be seen that the prosecution of this enterprise has vital relations to the future development of the city. It was supposed that all interests had been reconciled in the indenture of four parts which the city council in November last authorized the mayor to execute. It failed, however, to settle the terms on which the Boston and Albany Railroad Company might use its land for railroad purposes, and the city maintain over the same territory highways safe and convenient for travel. The last year closed before the negotiations on this point were concluded. I recommend that the consideration of this subject be resumed at an early day, in order that this great improvement may be entered upon by the parties in interest during the coming season.”

In view of these declarations an early arrangement of the terms on which the company may use its terminal freight grounds on the deep water of the harbor consistently with the safety and convenience of public travel may confidently be looked for. Should this expectation be disappointed, it would be desirable for the legislature to consider whether the solution of the difficulty may not be found in a modification of the terms on which the legislature has authorized the Boston and Albany Railroad Company to get access to deep water in South Boston. (Chap. 461, Stat. 1869.) On the settlement of this one outstanding question, the Board see no reason why this long-baffled undertaking may not be begun.

PURCHASES.

The Board has purchased of Benjamin R. Meins and Joseph C. Storey, with the approval of the governor and council, one undivided seventh more of a parcel of flats in South Boston, situated on B Street extended, for \$3,300 and the taxes for the year 1869, amounting to \$23.30. There now remain but one undivided seventh more of this parcel, and three undivided eightieths of another parcel, of the tract of South Boston flats between B and E Streets, which the Commonwealth has been unable to purchase on reasonable terms, of the riparian owners. It will probably be necessary

to institute proceedings for partition in reference to these outstanding fractional interests that the Commonwealth may hold its own in severalty.

As the water covering the greater part of these purchased flats is too shallow to be filled advantageously with material taken from the harbor and borne by scows, the Board would recommend that the law for the occupation of this tract be modified so that, if expedient, it may be filled with other material, subject to the law of compensation for tide-water displaced.

WORKS IN BOSTON HARBOR AND ON THE COAST OF MASSACHUSETTS.

During the past year, work has progressed upon the seawalls at Long Island and Point Allerton, and in dredging out a channel through the upper middle bar as fast as the limited appropriation last year by Congress would admit. The appropriation in 1871 was \$100,000; that in 1872 but \$75,000. Appropriations like the last become exhausted before the working season is over. This involves delay in the progress of the work and makes it more expensive to the government, as every resumption of work after it is once discontinued involves a repetition of the cost of the necessary preparations preliminary to a beginning. The Board has sent to Congress the memorial appended to this Report, calling attention to this subject, and will depute some of its members to go to Washington to press it upon the attention of the government, in the hope that for the future larger appropriations may be made for work indispensable to preserve the chief port of New England from deterioration, and adapt it to the increasing demands made upon it by the largest class of ocean steamers.

All the government work in Massachusetts done to improve and preserve harbors during the past year, has been in charge of Gen. George Thom. of the U. S. Engineers. His administration in this State has been marked by great efficiency and a judicious economy in expenditures, that have made the appropriations accomplish the greatest amount of good. His relations to this Board have been especially gratifying. By the courteous permission of Gen. A. A. Humphreys, Chief

of U. S. Engineers, the Board is able to append Gen. Thom's report upon the works in this State under his charge during the past year. By the same courtesy the report of Gen. H. W. Benham, of the U. S. Engineers, in relation to some projected work upon sea-walls in Boston Harbor is also added.

CHARLES RIVER.

In the month of June, last, application was made to this Board by George Griggs, James S. Whitney, J. C. Hoadley, Edward Atkinson, and C. H. Heath, Trustees, and the Boston and Roxbury Mill Corporation, for a license under chapter 236 of the Acts of the year 1872, to build a sea-wall on their own flats on the southerly side of Charles River, and to fill these flats inside the wall. Notice was given of this application to the mayor and aldermen of the city of Boston, and to the mayor and aldermen of the city of Cambridge, also, for the reason that the line of occupation adopted on the Boston side of Charles River could not but effect the line to be adopted on the Cambridge side, and because the future of the Cambridge shore is fast becoming a practical question. In response to this notice the Board received a protest from the city of Cambridge against authorizing any filling on the Boston side of the river, until a general scheme for preserving and improving the Charles River basin had been adopted. Mr. Charles Davenport, also a large proprietor of flats and marshes on the Cambridge side of the river, appeared before the Board while this case was pending and submitted his favorite plan for occupying both sides of the basin, reserving a water-course through the middle of it, twelve hundred feet wide. The Board did not think that it would be just to arrest the development of the Boston shore for the indefinite period required for the adoption of a general scheme for preserving and improving this water-area. It was, however, of the opinion that the line for occupation to be fixed on the Boston side should be one in harmony with the flowage of the river, that could not conflict with any such general scheme that might be devised on the basis of preserving the present capacity of the basin as a tidal reservoir to Boston Harbor and giving it a symmetrical outline.

Such lines of occupation were drawn by Prof. H. L. Whitney, the engineer of the Board, and are given on the plan in the Appendix. His report shows that this line of occupation is such that if the flats inside of it are filled with the material of the flats outside of it, above the plane of low-water mark at spring tides, the capacity of the basin as a tidal reservoir will not be diminished, and except at the lowest tides, the basin will be wholly covered by water.

He says :—

“ I found the occupation of the tidal prism, by the existing flats of the basin under consideration, to contain about 39,500,000 cubic feet. It only remained to make such adjustment of harbor lines as would leave this amount of reservoir capacity by transferring or transposing such a portion of the flats outside of such harbor lines as would compensate or balance the displacement of tide water within such lines. In other words, to determine such harbor lines as would preserve the present tidal prism of the basin by making the excavation of flats outside of them to the plane of low water balance the filling within the same line to the plane of high water.

“ By the lines I have prescribed, the amount of gain by excavation outside of them will equal about 39,500,000 cubic feet, and the amount of loss by displacement of tide-water within these lines will equal about 39,300,000 cubic feet, leaving a slight contingent balance in favor of the scheme. In the adjustment of these lines I considered it important to adhere to natural and harmonious lines of flowage as well as those practical and useful for the occupation and utilization, both of the land and water frontage.

“ In regard to the line along the front of the ground proposed to be improved on the south side of the basin, between the western sluice-way in the mill-dam and the Brookline bridge, I have not conformed to the line suggested by the parties in interest, although I have given what I consider a full share of advancement upon the basin along this front. But part of the shore already presents a salient point in the outline of the basin which should not be exaggerated. By doing so, the flowage would be disturbed and misdirected, and the outlines of the basin as a whole, be distorted and not in harmony with its remaining shores.

“ For like reasons I have cut off the abruptly protruding points of marsh on the Cambridge side. These points are of no local value, and no useful line could be determined which followed the present uneven outline of the marsh. The best use that can be made of

these extreme points is to take the material beyond the lines prescribed for filling the adjoining indentations within the lines.

“So far as practicable I have drawn the harbor lines on the Cambridge side with regard to already existing improvements upon the upland, such as making the front parallel to the line of the Boston and Albany Railroad, and to Main Street in Cambridge, and to West Boston Bridge.”

The proper termini of the line of occupation on the south side of Charles River were the end of Abbott's Wharf,—a solid wharf near the Brookline Bridge,—and such a point at the sluice-way under the milldam that the line of occupation along the milldam below the sluice-way and the new line above should form a continuous contour in harmony with the flowage of the stream. In connecting the termini of the new line from the end of Abbott's Wharf to the sluice-way,—as there was no reason for departing from a straight line,—such a line was adopted, and the licenses were issued accordingly to Messrs. Griggs, Whitney and Hoadley, Messrs. Atkinson and Heath, Trustees, and the Boston and Roxbury Mill Corporation to occupy to this line so much of their flats as lay above the end of the existing harbor-line, paying compensation in money for the tide-water displaced by all filling not taken from the bed of the river above the plane of low water. The existing harbor-line on the northerly side of the milldam above the sluice-way was fixed evidently without any reference to the occupation of the shore immediately above, and requires adjustment to the line of occupation prescribed in these licenses granted by the Board. Such an adjustment the Boston and Roxbury Mill Corporation petitioned the Board to recommend to the legislature.

As there were a few isolated points in the new line of occupation from the sluice-way to Abbott's Wharf which were a little outside the low-water line it seemed desirable that the modification of the existing harbor-line should be coupled with the establishment of a new line to Abbott's Wharf along the shore above the point where the old line terminated. Accordingly, on the second of October last, a hearing on the establishment of such a line was given to all parties in interest, after publishing notice of it as required by law. No one objected to this line then proposed by the Board and shown

in the plan appended to this Report, and the same is recommended for adoption.

On the eleventh day of September last, Oakes Ames and 819 others, applied to the Board to recommend to the legislature such a modification of the harbor-line on the Cambridge side of the Charles River Basin, as would carry it several hundred feet further from the shore.

Accompanying this application was a large plan showing an occupation for buildings of the whole basin, except a water-space through it, 1,200 feet wide, and the reservation of a broad drive-way and park on the margins of this water-space on both the Boston and Cambridge sides. The Board published the legal notice of a hearing to be given on the sixteenth day of October last, on the subject of the revision of the harbor-lines on Charles River, between the West Boston Bridge and the Brookline Bridge. At the hearing, Hon. Geo. S. Hillard and F. E. Bryant, Esq., appeared for the petitioners; Lewis Stackpole, Esq., for the city of Boston; James B. Thayer, Esq., for the Boston and Roxbury Mill Corporation; Hon. Wm. Aspinwall, for the town of Brookline; George Putnam, Jr., Esq., for owners of real estate on Brimmer Street; and Francis Bartlett, Esq., for owners on Beacon Street. The petitioners urged in favor of the plan, that it would add a large tract of land on the Cambridge shore, suitable for expensive dwelling-houses, and increase by millions the taxable wealth of the community. In behalf of this plan the Board was asked to consent to the surrender of a much larger portion of the basin than could be occupied under existing harbor-lines, and to permit this without even the assessment for compensation for tide-water displaced. It was also stated for the petitioners that this water-area and these flats must have their character now determined, and that they would be devoted to commercial and manufacturing purposes unless provision was at once made for a different disposition of them.

It was objected in behalf of the city of Boston, and others in interest on the Boston side of the river, that such a plan required the coöperation of many parties to carry it out, especially of owners on the Boston side, and some guarantee that when so much more of the basin had been surrendered

for occupation for the purpose of a park and dwelling-houses, it would not be used for other purposes.

Apprehension was expressed that this plan contemplated the building of another line of houses in rear of those on Beacon Street; but such a purpose, against the will of the owners of these houses, was disclaimed by the petitioners. They did, however, declare emphatically that they should devote their land and flats on the Cambridge shore to commerce and manufactures, unless the harbor-line was carried farther from the shore, so that the park and drive-way should be built outside the existing line, and that they would establish no park on their side unless one was established on the Boston side. It was not denied by the petitioners that they could afford to make the improvement contemplated inside the existing harbor-line, and in the course of the hearing they proposed to give all the flats requisite, to anybody that would construct the park on the outer margin of the territory inside the existing line of occupation on the Cambridge shore. The Board was also desired to submit the scheme to the cities of Boston and Cambridge, to see if they would coöperate in its execution.

As bearing upon the proposition that there should be a park or broad drive-way in the rear of the houses on Beacon Street on the Boston side, a communication from Hon. Peleg W. Chandler, addressed to the city solicitor of Boston, was presented to the Board at the hearing, and is appended to this Report.

No estimates of the cost of the improvement or of the value of the land when improved were submitted to the Board. There was no evidence of any demand for this land for other than commercial purposes, and but little information of any sort was furnished by the petitioners.

The hearing was very meagre, no case beyond the map having been prepared, and none made out. It showed, however, that so far as this scheme of improvement on the Cambridge side is dependent upon a considerable extension toward Cambridge of the line of occupation on the Boston side, it must fail, as there was no disposition whatever manifested on the Boston side, to make such an extension. The original plan of the petitioners undoubtedly

contemplated such an approximation of the Boston and Cambridge lines of occupation, and a connection of them by bridges as would assimilate the uses and values of the land to be made on each side of the river, and practically incorporate a considerable part of the Cambridge territory as a part of Boston, by connecting it with Boston so closely. The failure of Boston to favor the approximation of the two sides of the basin, makes it necessary that this improvement should be maintained, if at all, for the enlargement of the area it secures for house building in Cambridge alone, and reduces largely the speculative interest in the scheme.

Assuming that these flats on the Cambridge shore can be profitably occupied by their owners for house-lots, what are the objections to licensing the occupation? The great objection on the part of this Board is, that the Charles River Basin is one of the tidal reservoirs whose action maintains at their present depth the navigable channels of Boston Harbor. The maintenance of this basin has vital relations to the preservation of Boston Harbor as a harbor of the first class, accessible to the largest ships. The future not only of Boston, but of Cambridge, is dependent upon the preservation of this harbor in at least as good a condition as now. Let its main channel show a diminution of depth by one foot, and real estate in Boston and the whole neighborhood will be depreciated.

Still, however, it is true that the reservoirs of the harbor must be encroached upon in the very process of developing the water-front on, and connected with the harbor, and the Commonwealth has provided in the law requiring compensation to be made when the tidal reservoir is reduced, for the accumulation of a fund whose income will defray the cost of dredging away any shoaling that may result from a reduced tidal reservoir. But this compensation fund is accumulated, not because Boston Harbor can be better preserved by dredging machines than by maintaining the natural scour caused by the tidal reservoirs, whose action is independent of human effort and human supervision and costs nothing; it is accumulated to remedy the injury that is *necessarily* done in adapting a water-front to commercial uses, because this is the best that can be done to preserve the harbor, and at the same time

use it. Where a water-front is needed on Boston Harbor, or its tributaries, for purposes of commerce, there exists an exigency for encroachment on such terms as will provide the only possible remedy for the unavoidable injury. But for an encroachment for the purpose of making house-lots there is no exigency whatever. There is no such dearth of land for building purposes in the neighborhood of Boston, that there is any occasion for obtaining it by filling up the harbor or destroying its reservoirs.

The Board is of the opinion, therefore, that not only should no filling for the purposes contemplated by the petitioners be allowed beyond the present harbor line, but that the law establishing the existing line should be repealed as a line of *continuous solid filling*, and that Prof. Whiting's line, before referred to, and shown on the annexed plan, be adopted as the line of continuous solid filling with material taken from the basin. This line is based on the only principle upon which the shore can be improved and the tidal reservoir maintained. The existing line is too far from the shore for the purposes of commerce and sacrifices the tidal reservoir, if maintained as the line of solid filling. It was established in 1847, before the United States Commissioners on Boston Harbor had begun their surveys and investigations, completed in 1866, and before the exigency that existed for preserving the tidal reservoirs of the harbor was known. They had not then made the emphatic declaration that startled the community and aroused it to the necessity of staying the progress of uncompensated encroachment. They said, "The upper harbor of Boston, because of the local value of its main channel, and because of the indirect value of its tidal volume to adjacent portions of the lower harbor channels, *cannot in our opinion afford to lose another cubic yard of tide-water.*"

Their conclusions were at once accepted by the Commonwealth, and the policy was adopted of maintaining against all encroachment not demanded by commerce, or other public interests, the tidal reservoirs of Boston Harbor as essential to its preservation and of permitting no encroachments whatever except under a law providing for compensation for the tide-water displaced.

The abolition of the present harbor-line on the Cambridge shore, and the adoption of the proposed line, as a line of continuous solid filling with material taken from the basin, are accordingly desirable measures. They are in the line of the policy of the State and the recommendations of the United States Commissioners and the United States Advisory Council to this Board.

The existing line on that shore has been an invitation to schemes like that of the petitioners for destroying the basin of Charles River. The substitution of the new line, based upon a sound principle of conserving the resources of Boston Harbor will put an end to such efforts, and bring all plans for the occupation of the Cambridge shore for dwellings within limits of safety to public interests.

Should this water-front be hereafter demanded for commerce, a limit for wharves outside the proposed line can be fixed according to the necessities of the case.

MYSTIC RIVER.

The Boston and Maine Railroad Company presented to the Board a very important project for occupying, for a freight-yard and landing-place for coal and lumber, tracts of flats lying eastwardly of its bridge over Mystic River and on both sides of the channel. It was at first supposed that the Board would have jurisdiction of the case under the general law of 1872 (chap. 236). It was found, however, on investigation, that to fill the flats according to the project would carry the filling across one or more of the lesser channels of the river, worthless for navigation, but limiting the title of the company and the jurisdiction of the Board, which extends only to the line of riparian proprietorship, where no harbor line has been established on the shore. The occupation desired could only be authorized by the legislature.

In order, however, that this occupation might be on lines that would harmonize with proper lines for the whole river, the Board published notice that it would hear all parties interested in the revision of existing, and the establishment of new harbor lines for Mystic River, from its mouth to the Medford turnpike, on the 12th day of December last, and a project of new lines was then submitted. As this project

modified existing lines that had been adopted, on consultation with two of the present members of the United States Advisory Council, the Board was unwilling to adopt such a modification without submitting them to the council for approval. It has been impossible to obtain a meeting of the council in season for this Report.

Accordingly, the Board submits a project only for harbor-lines within the limits of the proposed occupation by the Boston and Maine Railroad Company and for the Charlestown shore above Chelsea Bridge, on the south channel of Mystic River. Mystic River being one of the tidal reservoirs of Boston Harbor, these encroachments in the interest of commerce will be under the law of compensation for tide-water displaced. The Board commends this project of the Boston and Maine Railroad Company to the attention of the legislature, as judicious and desirable. It gives a great and much needed increase to the terminal facilities of the road, and will relieve all parties from the temptation that has heretofore existed, to make an illegal use of the company's bridge over Charles River, for the reception of cargoes of coal and lumber unloaded from vessels lying at the bridge across the current in violation of law.

FORT POINT CHANNEL.

The Board also submit a modification of the harbor-line on Fort Point Channel, adopted by the Board after a hearing on the application of Wm. P. Hunt for a change of the line here, notice of the hearing having been published according to law.

The Board consider the line proposed a better one for the navigation of the channel than the existing one, and it allows the petitioner and other shore owners to occupy more of their own flats for wharf purposes where more wharf room is needed. The Standard Sugar Refinery objected to any change in the line, lest it should affect the interests of the company unfavorably. The territory of the company has been so occupied that access to it by vessels cannot be obtained without passing over the flats of the coterminous proprietor; so that if the harbor-line in front of this proprietor's flats were carried farther from the shore, and his flats occupied to the line, access to the company's land would be

entirely cut off. The new line proposed will not carry the point of occupation on the division line of these two estates farther from the shore than it is now.

The company may apprehend that, if the occupation of this additional tract is permitted, this proprietor will be less likely to yield favorable terms of accommodation, or be more inclined to occupy his flats, and thereby restrict the company to a more limited access to its landing than it now enjoys. But certainly it would be unjust to deprive an owner of flats of the power of occupying them on a line advantageous to navigation on account of this apprehension, which arises from the fact that the territory of the company is occupied so unreasonably near to the boundary line that an insufficient water-space is reserved for the approach of vessels.

The Board accordingly recommend the line shown on the plan appended to this Report for adoption by the legislature.

DRAWS IN CHARLES AND MILLER'S RIVERS.

An excellent new draw in Warren Bridge, with a new passage-way thirty-six feet wide, has been constructed by the commissioners on the Charles River and Warren Bridges during the past year. It is operated by steam-power, with great facility and dispatch, and is unquestionably one of the best draws in the neighborhood of Boston.

Plans for new draws and passage-ways thirty-six feet wide in the passenger bridges of the Eastern and Boston and Lowell Railroads over Charles River, and in the Eastern and Boston and Maine Railroads over Miller's River have been approved by the Board. The time from February 1st to March 15th of the current year has been fixed for such work in constructing these draws as will interfere with navigation and notice of the fact published in the newspapers. These companies have assured the Board that during this time the draws shall be built.

The commissioners on Charles River and Craigie Bridges are about to submit plans for a new draw in Craigie Bridge, and of other projected improvements to be executed this year. When, besides these, a new draw in Prison-Point Bridge has been built by Cambridge and Charlestown, one in the freight-bridge of the Boston and Lowell Railroad, and another in the

West Boston Bridge, the reformation in the draws and passage-ways for vessels on Charles and Miller's Rivers, urged by the Board upon the legislature of 1869, although somewhat curtailed in its proportions by subsequent legislation, will have been accomplished.

THE MILLER'S RIVER NUISANCE.

The Board in joint action with the state board of health devoted a good deal of its time to the discussion and preparation of a plan for abating the nuisance in Miller's River. The best course to be adopted in dealing with this subject was made very clear to the joint commission by the thorough investigation of the nuisance, its causes and remedy, made by Mr. Phineas Ball, C. E., of Worcester, in the service of the commission, and his elaborate report upon the same.

The commission reported under the statute (chap. 353, Statutes 1872) to the mayors and aldermen of the cities of Cambridge and Somerville the following plan:—

“*First.* That the city of Cambridge complete its system of sewerage, so that such portion of its territory as is now drained into Miller's River be drained into sewers already made or projected, having their outlets into Charles River.

“*Second.* That the city of Somerville construct a main sewer, from Milk Street through Prospect, Washington and Cambridge streets, into Tufts' Dock in Charlestown, on Mystic River, and connect with this main sewer, lateral sewers, in such a manner that whatever now drains into the Miller's River basins will drain by this main sewer into the Mystic River, and that the city of Somerville obtain the requisite legislation to carry this main sewer through the territory of the city of Charlestown.

“*Third.* That the cities of Cambridge and Somerville fill up with clean gravel, to the grade authorized by law, all the channel, flats and basins of Miller's River, lying east of Prospect Street in Somerville, and south-west of the Boston and Lowell Railroad; reserving at first from such filling, through the middle of said channel and basins to the outlet under the Boston and Lowell Railroad, a space not less than fifty feet in width, where such a width is possible, until the drainage of the territory of Cambridge and Somerville, now leading into these basins, has been diverted from them into Charles and Mystic Rivers, as herein before provided, and then in the months from November to April inclusive, finally remov-

ing from this reserved space the mud which has there accumulated in the process of filling the adjoining areas.

“*Fourth.* It will then remain to enforce those sanitary principles which the Commonwealth has already adopted with reference to industries of the class peculiar to this neighborhood.”

The commission adopted no temporary measures in regard to this nuisance, because it was conceded by the representatives of both cities, and of all other parties appearing before the commission, that none could be devised that would give any substantial relief, and such was the unanimous opinion of the commission.

The expenses of the surveys and estimates made by the commission have been duly paid by the two cities, as required by the statute.

INFORMATIONS.

The decision in the information at the relation of this Board against Benj. F. Woods for erecting and maintaining a dam across Mystic River without legislative authority, had been made when the last report of the Board was presented, but the opinion of the court in the case given by Chief Justice Chapman had not been filed.

As a construction is given in this opinion to some provisions of the statute establishing the Board, and affecting the construction of works in tide-water, it is included in this report.

Opinion of Chief Justice Chapman in Attorney-General vs. B. F. Woods.

The information is filed at the relation of the Harbor Commissioners of the Commonwealth to restrain the rebuilding of a dam across Mystic River, a small stream flowing into Boston Harbor. It has been used from time immemorial for pleasure-boating between the harbor and Mystic Pond, which is situated a short distance above the dam. Since 1851 pleasure-boats have passed the dam daily during the summer, and their passage has been seriously obstructed by the dam. It is denied by the defendant that the river, at this point, is within tide-water; because it is said that although the rise and fall at this point is two feet, yet it is occasioned by the meeting of the salt-water of the tide with the fresh-water that comes down the stream. But the law on this point is well settled. It is the rise and fall of the tide, and not the proportions of salt water and fresh,

that determine whether a particular portion of a stream is within tide-water. This was settled in *Rex vs. Smith*, 2 Doug. 441, in application to the Thames at London; in *Peyroux vs. Howard*, 7 Pet. 339, in respect to the Mississippi at New Orleans: in *Lapish vs. Bangor Bank*, in respect to the Penobscot at ———. The same doctrine must apply to small streams as to large ones. We have no doubt that defendant's dam is within tide-water.

It is also denied that the stream is navigable, although it is about two feet deep at low water: because it is not proved to be used for the purposes of navigation except with pleasure-boats. The case of *Rowe vs. Granite Bridge Company*, 21 Pick., § 4, is cited to sustain this position. Chief Justice Shaw there says: "It is not every small creek in which a fishing-skiff or gunning canoe can be made to float at high water which is deemed navigable. But it must be navigable to some purpose useful to trade or agriculture." The same thing in substance is stated in *Charlestown vs. County Commissioners*, 3 Met. 202; *Murdock vs. Stickney*, 8 Cush. 115. But this language is applied to the capacity of the stream, and is not intended to be a strict enumeration of the uses to which it must be actually applied in order to give it this character. Navigable streams are highways; and a traveller for pleasure is as fully entitled to protection in using a public way, whether by land or water, as a traveller for business. Certainly fishing and fowling are as really regarded on navigable waters as trade and agriculture, though not mentioned in the cases cited above; and in *West Roxbury vs. Stoddard*, 7 Allen, 171, it is said that the use of great ponds which are public property may as well be for bathing, boating, skating, fishing and fowling as for business, and is entitled to equal consideration. If water is navigable for pleasure-boating, it must be regarded as navigable water, though no craft has ever been upon it for the purpose of trade or agriculture. The purpose of navigation is not the subject of inquiry, but the fact of the capacity of the water for use in navigation. The use that is actually made of Mystic River proves that it is navigable.

The dam is within the public domain; for at the point where the tide, from natural causes, ebbs the lowest, is the boundary of the flats beyond which private titles do not reach. *Sparhawk vs. Ballard*, 1 Met. 107. Beyond that point the legislature has control for the common benefit of the public, and structures that interfere with the common right of navigation are a nuisance at common law. The legislature has a right to make reasonable restraints for the protection of the public, and enforce them by reasonable penalties. *Commonwealth vs. Alger*, 7 Cush. 92.

By stat. 1866, c. 149, the legislature has made provision for these public interests. It creates a Board of Harbor Commissioners, and

confers on them the general care and supervision of all our harbors and tide-waters, and the flats and lands flowed by such tide-water, except the Back Bay lands, respecting which other provisions are made. It designates particularly some of the duties of the Commissioners. By section 5, all erections and works made without authority from the legislature, or in any manner not sanctioned by the Commissioners, when their direction is required, as provided in the statute, within tide-waters flowing into or through any harbor, shall be considered a public nuisance, and liable to indictment as such. The prohibition extends to ordinary high-water mark. *Commonwealth vs. Roxbury*, 9 Gray, 451; *Commonwealth vs. Charlestown*, 1 Pick. 180. The defendant's claim is within this clause, there being no authority for its erection derived either from the legislature or the Commissioners. This section further provides that the Commissioners shall have power to order suits on behalf of the Commonwealth to prevent or stop, by injunction or otherwise, any such erection or other nuisance in the tide-waters which flow into or through any harbor in the Commonwealth. The attorney-general and district attorneys are directed to commence and conduct such suits.

It is contended that there is no remedy in equity exists, if there is a full and adequate and complete remedy at law, and that an injunction should not issue unless it appears that irreparable injury is to be prevented. Authorities which are applicable to ordinary suits in equity are cited to sustain these positions. But the statute gives special remedies, and designates the cases to which they shall be applied. The remedy by injunction is cumulative.

The purpose of the statute is not only to punish all encroachments upon this portion of the public domain, but to furnish means for their prevention or removal. It cannot be doubted that the legislature has power to do this, and to prohibit all invasions of the rights of the public, without regard to the amount of damages occasioned by them. But in the present case the report finds that the obstruction to the navigation of the river by the plaintiff's dam is such as to create a nuisance of a serious character.

Injunction to issue.

The dam, so far as it obstructs navigation, has been removed. A final decree, however, in the case determining the extent to which the obstructions of the river are to be removed, has not been entered.

The Board, on the ninth day of October last, requested the attorney-general to bring an information against the Boston and Lowell Railroad Corporation to restrain it from filling

flats and driving piles on Miller's River, in violation of section 5, chapter 149 of the Acts of the year 1866. The corporation claims that, as it had begun this work prior to the year 1866, it is excepted from the operation of the statute. This claim seems to the Board manifestly wrong, as the statute only excepts legislative grants and licenses given prior to 1866, under which, at the time when the statute of 1866 was passed, the work authorized had been begun. But the work done by this corporation is authorized by no legislative Act whatever. Such a claim, if admitted, would take the whole shore from high to low-water mark, or the hundred-rod line, if it had been occupied to any extent prior to 1866, out from the operation of the statute, and greatly impair the value of the law.

It is expected that the case will be heard before the full bench of the supreme judicial court during the coming spring.

The Board, on the eighteenth day of December last, caused an information to be filed against Wm. T. Hart, Charles P. Clark and G. T. Olyphant, trustees of the Berdell bondholders under a mortgage of the Boston, Hartford and Erie Railroad Company, to restrain them from filling solid, in violation of law, about 650 feet of the pile bridge of the railroad across South Bay, which served as a sluice-way for the passage of the water to and from the two portions of the bay into which the railroad divides it, and which is outside existing harbor lines.

Section 5, chapter 310 of the Acts of the year 1864, is as follows: "So much of the railroad of the Boston, Hartford and Erie Railroad Company as is located upon the South Boston flats, inside of the commissioners' lines of solid filling, shall be constructed upon solid filling or upon piles, as shall be determined by the governor and council."

Under this Act the governor and council authorized the road across South Bay to be built solid, with a sluice-way through it not less than 400 feet wide. The road was built, reserving about 286 feet of pile-bridge at the lower end, and about 650 feet at the upper end of the bay for such sluice-way, and this structure of the road continued to the month of December last. In 1871 the legislature passed an Act entitled "An Act for the improvement of navigation in South Bay and the modification of its harbor lines," the design of which was to secure

the deepening of South Bay west of the railroad by prohibiting any filling east of the railroad or elsewhere, except with material taken from that part of the bay which is to be deepened and reserved as a permanent basin for shipping.

This basin affords one of the most valuable and rapidly developing water-fronts of Boston. Within the past year the number of passages made by vessels through the Dover Street Bridge, at the entrance of South Bay, has increased from 6,564 to 8,050, showing an increase of passages through the draw of 1,486.

For the purpose of securing the improvement of this bay in the same manner that the Commonwealth proposes to improve Boston Harbor, by excavating shoals and using the material to fill up its flats, the legislature passed this Act of 1871, containing the following provision :—

“No person shall drive any piles, build a wharf, wall, pier or other structure, or do any filling in tide-water on such land and flats (i. e. in the tide-waters of South Bay), except in accordance with the terms of such license (i. e. of the Harbor Commissioners, approved by the governor and council), and subject to the provisions of section four of chapter 149 of the Acts of the year 1866, and of chapter 432 of the Acts of the year 1869,” the statute of 1866, authorizing the Board and the governor and council to require all filling to be done with material taken from the bay. The statute of 1871 contained also the provision that “nothing contained in this Act shall be construed to affect or take away any private rights which cannot lawfully be affected or taken away without compensation therefor.”

In December last the trustees under the Berdell mortgage proceeded to fill up with solid material the whole of the 650 feet of pile-bridge at the upper end of the bay, leaving but 286 feet of sluice-way at the lower end, and so encroaching to the extent of 114 feet on the reservation of 400 feet for sluice-way prescribed by the governor and council in 1864, and to the extent of 650 feet upon the prohibition of the Act of 1871.

The trustees say, that the statute of 1871 being general in its terms cannot be held to revoke a specific license given by the governor and council. But the statute of 1871 is universal in its application, and expressly prohibits all parties

from doing what has been done, and, furthermore, not even the terms of the license of the governor and council have been kept, as only two hundred and eighty-six feet of sluice-way have been left, where this license required four hundred feet. It is also said that the statute of 1871 does not apply, because the filling has been done where some thirty or forty years ago there was an upland marsh, which was then excavated to obtain material for filling South Cove, and has ever since formed the bottom of South Bay, and the legislature, it is said, has no right, without paying the owners for their property, to prevent this territory from being reconverted into solid land.

The statute of 1864, however, prohibited occupation in South Bay with solid filling by the Boston, Hartford and Erie Railroad Company, except so far as authorized by the governor and council, and contained a provision similar to that of 1871, that this prohibition should not affect or take away private rights without compensation.

The Boston, Hartford, and Erie Railroad Company, so long as it was in possession of the road, acquiesced in the right claimed by the legislature to prohibit the reoccupation of these excavated marshes without paying for so doing, and recognized the license of the governor and council given under the statute of 1864 as the basis of its authority to make any solid filling whatever in South Bay. The trustees deny the right of the legislature to keep this territory flowed by tide-water, or to prescribe the conditions on which a portion of it may be filled without compensation to the owners, and this is the main issue to be determined.

It is very important that the jurisdiction of the legislature over these waters be maintained,—they are of so much value to commerce. The Board does not believe that, when parties have voluntarily and permanently brought their land within the ebb and flow of the tide-waters of one of the great ports of the country, that the tide-waters flowing these lands are exempt from the jurisdiction the legislature has over all tide-waters to regulate and control their diversion or displacement. Such territory stands in the same position as flats between high-water mark and the riparian line of title. Flats are private property. Nevertheless the legislature has the un-

doubted right to prohibit, in the interest of the public, their occupation, and to keep them flowed by the tide without making compensation to their owners. (*Commonwealth vs. Alger*, 7 Cush. 53.

BOSTON AND LOWELL RAILROAD CORPORATION.

The legislature of 1872, by chapter 359, authorized the Boston and Lowell Railroad Corporation to occupy the triangular space between the old and new locations of the passenger bridges of the corporation and the line of solid filling from the Boston shore of Charles River in such manner as this Board should approve, the corporation paying the Commonwealth such compensation as the governor and council should determine to be just and equitable. This triangle was appropriated by the corporation under circumstances stated by the Board in its last report. The governor and council have appraised it at fifty cents per square foot, leaving the measurement to be made by the Board. The Board finds the area to be 12,050 square feet, and has accordingly executed a license to the corporation to occupy this triangle with a bridge-structure as already built upon paying into treasury of the Commonwealth \$6,025.

COMPENSATION FOR DISPLACED TIDE-WATER.

The Board has made during the past year, under chapter 149, section 4, Acts 1866, the following assessments for tide-water displaced in the localities named:—

Joseph F. Paul, South Bay,	\$189 81
John W. Letherbee, South Bay,	80 12
Nathaniel Winsor, Fort Point Channel,	53 17
Albert R. Whittier, South Bay,	66 15
Albert R. and Seth Whittier, South Bay,	177 60
Fitchburg Railroad Company, Charles River,	119 43
Boston Gas Light Company, Boston Harbor,	1,899 21
Malachi Clark, Fort Point Channel,	75 00
Martin Brimmer, T Wharf,	12 00

EDGARTOWN HARBOR.

In reference to the memorial of the Board in behalf of Edgartown Harbor, Congress appropriated last year twenty

thousand dollars for reopening the outlet of Cotamy Bay through Cotamy Beach. The work comes within the district assigned to Gen. George K. Warren, of the United States Engineers, and will probably be done during the present year.

MEADOWS AND FLATS OF EAST-HARBOR CREEK.

By chapter 20 of the Resolves of 1872 this Board was authorized and directed to consider and determine whether the meadows and flats in Provincetown and Truro, formerly drained by East-Harbor Creek, can now be drained either by an outlet through the dike built across said creek by the Commonwealth or by any other means without injury to Cape Cod Harbor, and, if this question were decided in the affirmative, then the Board was to construct the requisite work to secure such drainage. The Board was also authorized to compromise and settle all claims against the Commonwealth for damage done to these meadows by the construction of this dike. The dike having been built under the direction of Mr. James B. Francis, of Lowell, one of the most eminent engineers in the country, the Board was unwilling to undertake the construction of any work having such close relations to the work done by him without consulting him. It accordingly submitted to him a series of inquiries, the answers to which, it is believed, will show what is best to be done.

On the 6th of August last, the Board, in company with Mr. Francis, went to Provincetown, and in accordance with a previously published notice, gave a hearing to all parties in interest. In the published notice all persons who had claims for damages caused by the dike were requested there to present them. But one claim was presented; the other parties stating that they were not prepared. On the following day the Board visited the dike and meadows in company with the parties in interest, and arranged with them that they should make up their claims and present them in writing to the Board in Boston. Subsequently they requested the Board to allow them until next year to determine what claims they would present, giving as a reason, that the full effects of the dike had not yet manifested themselves. At the desire,

therefore, of all parties in interest, action has been postponed to another year.

MANCHESTER.

The Board was called upon by the county commissioners of Essex County, to determine, under chapter 203 of the Acts of 1856, whether in laying out a new highway in Manchester, a draw would be required in the bridge in this way across the creek adjoining the Eastern Railroad.

The Board visited the locality and heard the parties claiming that the bridge should be built with a draw. These parties were the owners of what could hardly be called a wharf, at the head of the creek,—a short section of wall filled in behind, which served as a landing and mooring place for a few small boats. It might have cost originally two hundred dollars.

The Board believed that all rights would be saved by constructing the bridge at a grade which would allow boats without masts to pass under it at high-water, and so notified the county commissioners.

CHATHAM AND MONOMOY.

There have been, in the history of our coast, few instances of changes on so grand a scale as those now in progress at the elbow of Cape Cod. The Nausett Beach, which is a strip of outlying sands parallel to the main shore, has been for some years wasting away, and seems finally to be breaking up in front of the town of Chatham.

While this beach remained intact it defended the main-land from the attacks of the sea, but during the past fourteen months the waves have several times rolled in furiously upon the town front, sweeping away many acres of upland.

After the storm of November, 1871, which inaugurated to some extent a new order of things, Prof. Benjamin Peirce, superintendent of the coast survey, Rear-Admiral Charles H. Davis and Prof. Henry Mitchell,—a majority of our advisory council,—accompanied by Prof. H. L. Whiting, visited the scene and instituted inquiries into all the circumstances of the case. Prof. Peirce, becoming satisfied that the changes were important, and had, perhaps, some connection with the move-

ments of the beaches and shoals at the entrance to Nantucket Sound, where some of the channels have recently undergone great changes, ordered systematic surveys to be made. These surveys have been undertaken, and a copy of Prof. Mitchell's report upon the results thus far obtained, has been furnished to this Board and appears in the Appendix. This report goes critically into the physical history of the neighborhood, from the visit of *Poitrincourt* in 1606, down to the close of last year. It shows that the *littoral cordon* of sand which acts as a bulwark to this part of Cape Cod has, at least once before, broken up in this neighborhood, but that the main-land suffered very little from the attacks of the sea between 1606 and 1847. The Minot's gale of 1851, made the first important inroad, and at that time Ram Island and other pasture-lands fell a prey to the sea. The gale of November, 1871, and subsequent storms have torn the borders of the uplands for a considerable distance. Near the lighthouse the brow of the bluff has fallen back a hundred feet within a few months. The report furnishes a table of areas of the beach in front of Chatham from surveys of 1847, 1868 and 1872, from which it appears that between the first two dates a loss of sixty-three per cent. took place; and nearly one-half of the remainder of the section disappeared between the last two dates.

While these changes have been going on about Chatham, the peninsula or island of Monomoy has been extending itself southward into Nantucket Sound, adding about a half-mile of dry land to the point within fifteen years.

The decline and final ruin of the valuable little harbor of refuge known as the Powder Hole, is commented upon in this report, and its history carried back to 1802, when it was accessible with three to four fathoms of water, and furnished good shelter. As late as 1854, three fathoms, at low tide, could be carried in, and the port was still of great value as a shelter for coasters and a rendezvous for fishermen. Prof. Mitchell predicts that a new bight and a grand anchorage-ground will be one of the ultimate effects of the natural movements now in progress. There is, perhaps, no point upon our coast where a harbor of refuge would be a greater mercy.

The results of the hydrographic survey of the shoals and channels off Monomoy are not yet in such shape that safe conclusions as to the amount of change can be stated. This work will be continued another season.

NANTUCKET HARBOR AND THE HAULOVER.

In our report of last year we referred to the project for opening a passage-way from the Nantucket Harbor to the sea through the beach known as the Haulover. All the information possessed by the Coast Survey had been placed before us, but most of this being quite old, Professor Peirce, the Superintendent of the Coast Survey, ordered resurveys to be made in order that the data upon which the citizens of Nantucket should base their claim upon the attention of Congress might be as full and recent as possible. A hydrographic survey of the upper harbor was made by S. D. Granger, of the Coast Survey, who was directed to act under advice from Prof. Mitchell. The whole of this survey is not yet plotted. A topographical resurvey was made by Prof. Whiting, of the site of the proposed engineering operations, which had in view, not only the collection of data which should be useful in the planning of the work, but in the settlement of a physical question that had arisen concerning the nature of this beach. Intelligent citizens of Nantucket had held the opinion that the Haulover Beach was a remnant of the drift formation and not a creation of the sea, and it had been argued that if a resurvey should show no falling back of this beach, it might be claimed that this barrier had not been thrown up by the sea, but had resisted by its solidity the action of the waves, and that if opened artificially, it would be kept open by the tides.

Prof. Whiting made a careful comparison of the condition of this beach, as shown by his first survey in 1846, and his last, made in 1872, and found the mass of the beach had moved in a period of twenty-six years. The outer face had been worn away and the beach made narrower. He conceives that this beach, even if a creation of the sea, was formed prior to the existence of Great Point and Coatoe which incloses the harbor, and that the tidal conditions are so changed that there is reasonable ground for supposing that the tidal currents will

maintain an inlet, and strongly recommends the project for opening the beach as worthy of trial.

VINEYARD HAVEN.

Under the date of April 13th, the Board received a memorial, signed by D. W. Stevens and forty-seven other citizens of Vineyard Haven, calling its attention to the want of proper shelter in Vineyard Haven. This subject had frequently been discussed in the meetings of the Board, before the above-mentioned memorial came before it, but the case has seemed to present so many critical points that its consideration has been deferred until it could have full information. Reports were current that the harbor had been filling up rapidly, and that the promontories at its mouth, known as "East Chop" and "West Chop," were wasting away so as to increase the exposure of the anchorage-ground. To ascertain precisely the facts upon which such reports might be founded, the Board applied to Prof. Peirce, Superintendent of the Coast Survey, who immediately ordered a reëxamination of this port, and visited the scene himself as soon as his parties were on the ground.

The following extracts from the report of Prof. Mitchell, who conducted the physical survey, will serve to illustrate the intrinsic difficulties of the improvement problem, as well as to dispel any fears of a natural decline in the capacity of the port:—

"The access from the Sound is free and direct, so that a very large majority of the vessels that seek the anchorage employ no pilots. But ports free and direct of access are liable, as a general rule, to be so exposed in storms as to render them unsafe; and Vineyard Haven is not an exception in this particular. The ship that runs into this anchorage before a northeast gale leaves an open door behind her. * * * *

"*Improvement of Vineyard Haven.*—The employment of steamers in our coasting-trade has not only failed to diminish the sailing-fleet, but really does not seem to retard the steady increase of the latter; and one of the problems that must soon demand solution is, how to provide room and shelter for these vessels at Vineyard Haven. This problem I have studied with great interest, but not

with much hope of success. I shall venture to touch lightly upon it, simply to indicate some initial steps in improvement.

“Any one who has witnessed a rush of vessels into Vineyard Haven has observed that they all crowd in towards the centre, frequently with mutual injury, while in the upper part of the cove, and along either side, there remain large spaces unoccupied. Of course this is due, in part, to the timidity of the skippers, who do not know the character of the bottom near the land; but in greater part it is due to forethought of anchorage-room on getting under way. I have seen the entrance to the roadstead so blocked with vessels at anchor that I have been afraid to attempt to run through the fleet into the unoccupied space (nearly thirty per centum of the whole anchorage), which lay higher up the cove.

“If mooring-buoys were to be placed along the margin of the anchorage-ground, they would not only define the limits, so as to induce vessels to run boldly up the cove, but they would themselves supply means for securing at least fifty vessels in locations not now in common use. Proper police regulations could provide that vessels running in by daylight should leave the entrance free for those arriving after dark.

“The form of the cove fits it peculiarly for this arrangement of buoys, since there are few irregularities in the submerged contours. The west shore is foul at some points out to the 10-foot curve, but the head of the cove and the east shore are generally free of rocks. The mooring-buoys might be placed along the 15-foot (at low water) curve, and thus accommodate ordinary coasters.

“Of course, vessels would usually be obliged to let go their own anchors, but they would prefer to do so near these buoys, to which, in case of a gale, they could make fast. They would also desire to make fast to them in getting under way.

“The hope of providing shelter for this roadstead is small. The entrance must not be closed by jetties from the Chops; and the building of an isolated breakwater outside is impracticable because of the great depth of water and the strong tide. The opening of a passage-way from the roadstead to the Lagoon is entirely practicable, and would not be very expensive, but this lagoon would freeze in winter, and remain frozen for long periods, perhaps. In this lagoon, as it now exists, without removal of its shoals, there is ample depth and area for forty-two merchant-vessels swinging as free as in the roadstead, or quite double that number packed closely, as they could conveniently be in so quiet a place. The whole area of the Lagoon is a trifle over 400 acres, against 544 acres of roadstead (having depth of eighteen feet and upward) in the haven.”

Relative to the present capacity of the roadstead, as compared with that shown by former surveys, Prof. Mitchell says :—

“Since 1845 the four and five fathom curves have moved out toward the Sound. This has resulted from a slight shoaling, probably due to the deposits of sand torn from East and West Chops by the sea. Professor Whiting’s surveys of the past season, compared with those of previous years, show that these two chops are losing ground at their extremities.

“Within the four-fathom line *all the submerged contours have fallen back* in more or less degree. This remark is to be understood in a general sense, because there are points where the curves have advanced and others where they have retreated, the retreat being in excess. In my paper on the ‘Reclamation of Tide-lands’ I offered as a theory, based on considerable observation and study of comparative surveys, that bays, exposed in the direction from which storm-winds are prone to blow, may be expected to extend; the contours within the influence of the waves having a tendency to fall back. Vineyard Haven, quite unexpectedly, furnishes me with another illustration, in a small way, supporting my views. Here, to be sure, the superficial area of the cove has diminished a little, not only because my limiting line, extending from East to West Chop, has fallen back a little, as the shores of these chops have washed away, but also because there has been a slight making-out of the beach along the sides and near the head of the cove. As bounded by the 6-foot curve, the cove has retained about its old superficial area; as bounded by the 12-foot curve it has enlarged four acres; and as limited by the 18-foot curve, it has enlarged from 515 acres in 1845 to 544 in 1871, a gain of twenty-nine acres; so that, far from there having taken place any decline of this port, a real improvement has been in progress.

“Only three first-rate men-of-war can be accommodated in the anchorage, and these must occupy the most exposed situations. Sixty merchant-ships can, however, now find swing-room in the anchorage, against fifty-six in 1845. Of miscellaneous merchant-vessels comfortably accommodated, I find the number to be 174; although Rev. D. W. Stevens, in charge of the ‘Sailor’s Free Reading-Room,’ reports that 200 have actually been seen anchored at one time, and that the average tonnage of those may be set down at 220 tons each. Of my 174, I claim that six per cent. is the gain since 1845.

“The dragging and fouling of ships in this anchorage are incidents exceedingly frequent. Vessels have had their masts cut away

to prevent dragging, and one vessel is reported by Captain West, the light-keeper, as having foundered. The largest number of vessels driven on shore in a single storm is stated by Captain West at sixteen, and by Rev. D. W. Stevens at fourteen. The following extract from the report of the 'Marine Agency of the Associated Press,' for the year ending March 22, 1870, will be found interesting:—

“*Arrivals.*—Steamers, 52; ships and barks, 83; brigs, 627; schooners, 6,350; whalers, 14; yachts, 25; sloops, 8—total 7,159; of which 410 were foreign, mostly British. Fishermen are not included in this list, but may be set down at 150 in the spring. Exclusive of the fishermen, the number of persons on these vessels may be set down at over seventy thousand.”

An examination of the report of Prof. Whiting, in the Appendix, shows some diversity of opinion between him and Prof. Mitchell upon the feasibility of constructing a break-water at the entrance of Vineyard Haven. The arguments of both these authorities are of great interest and value, and by a comparison of such views, and more thorough investigation upon the points of difference, a result may at last be reached that will be accepted as true by all. In this stage of the discussion the Board is not prepared to ask the general government to make any specific improvement of this harbor. It may, however, be found expedient to bring the subject to the attention of Congress to secure special investigation as to the best method of increasing the usefulness of this harbor or roadstead to the commerce of the country.

THE GENERAL LAW.

The general law passed by the last legislature has greatly increased the work of the office, but not beyond what could be properly done with the usual means at the disposal of the Board. It is believed that its provisions might be advantageously extended so that the Board, with the approval of the governor and council, might have jurisdiction below the line of riparian ownership on a shore where no harbor-lines have been established.

In Boston, Charlestown, Cambridge, Lynn, Gloucester, Wareham, New Bedford and Provincetown, harbor-lines have been established which limit by law the jurisdiction of the

Board, but there are many localities whose shores have not been considered of sufficient importance to be guarded by harbor-lines, where a wharf may be wanted beyond the line of riparian title, and cannot now be legally built until the legislature has met and granted the requisite authority. It would doubtless be a public accommodation if the Board, with the approval of the governor and council, could have jurisdiction of such cases.

THE PROPERTY OF THE COMMONWEALTH IN TIDE-LANDS.

Among the duties assigned to this Board by the statute establishing it is the duty "to protect and develop the rights and property of the Commonwealth in flats and lands flowed by tide-water." The purpose of the Commonwealth to deal with its domain in tide-waters as a property to be held, developed and disposed of as an estate, but at all times in complete subordination to the interests of commerce, and to the paramount obligation to maintain and preserve unimpaired all valuable navigable waters, was not for the first time declared in this statute of 1866. The Resolve of 1859, chapter 103 prescribing the duties of the land-agent, indicates the same purpose. Indeed, as early as 1850, the proprietary and vendible interest of the Commonwealth in tide-lands below low-water mark not exceeding one hundred rods from high-water mark, was strongly stated in the very able report of a commission appointed by the governor under an Act of the legislature of 1848, and consisting of John M. Williams, David Cummings, Thomas Hopkinson, George S. Boutwell and Charles Hudson. They said :—

"The right to manage and dispose of them (i. e. flats below the riparian line), is by the constitution of the Commonwealth vested in the legislature. The Commonwealth may by the Acts and in the discretion of the legislature, cause or permit them to be excavated or embanked, or retained or otherwise disposed of. It may grant them to the city, to the riparian proprietors, or to other persons or corporations, at such times, in such manner, on such terms and conditions, and for such considerations of public benefit, pecuniary or otherwise, as the legislature, in the exercise of its sound constitutional discretion, may judge to be most proper and most conducive to the public interest and welfare."

In the same year action was taken toward the assertion and development of the property of the State in the Back Bay. It is true that subsequently, in the year 1855, when the legislature bestowed on the Mystic River Corporation and the Boston Wharf Company their enormous gratuitous grants, this policy received a violent infraction, but the times were exceptional, and the true doctrine speedily recovered its ascendancy. It is interesting to notice that in tacit condemnation of these gratuities, measures were initiated in the very next legislature, and passed by the Senate, providing for the sale thereafter of tide-lands of the State in Boston Harbor, and the application of one-half of the proceeds to the harbor's preservation and improvement.

In 1861, chapter 176, the legislature authorized the sale of the tract in Charles River lying between the respective bridges of the Eastern and Boston and Maine Railroad Companies, and south of the line of the draws to these corporations at a price to be determined by the governor and council. In 1864 the legislature by law pledged these tide-lands and the proceeds of them to pay the scrip of the State that represents the war debt of the Commonwealth.

In 1868 the law was passed establishing the present basis on which the South Boston flats might be sold and improved.

In 1869 a tract of land in Charles River was sold at public auction under an Act of the legislature, and purchased by the Fitchburg Railroad Company at fifty cents per square foot. In the same year, it is true, that authority was given to the railroad corporations having bridges across Charles River to increase the amount of their pile-structures in that stream. It was coupled, however, with the condition that new draws in better locations should be built in these bridges, that they might be less obstructive to navigation. While undoubtedly it was the clear legal duty of the corporations to make their draws of sufficient width for the passage of vessels seeking to pass through them, the fact that this duty was insisted upon at the same time that the corporations obtained the right to increase their bridges, gave the burden then imposed the effect of an equivalent for these concessions. Under the legislation of 1872, as this Report has already shown, the Boston and Lowell Railroad Corporation was authorized to occupy a triangular

parcel of land in Charles River on paying its value as determined by the governor and council.

Upon the same basis of paying to the Commonwealth the value of the property, the city of Salem was authorized by the same legislature, at its extra session, to fill up territory of the Commonwealth, the occupation of which it was understood was to inure to the benefit of the Eastern Railroad Company.

This sketch of the salient points of the legislation of Massachusetts upon this subject, during the past twenty years, shows how deeply impressed upon it is the idea that the pecuniary value of the public domain in tide-lands belongs to the public treasury, and is not to be squandered in free gifts to the importunate. Yet in the face of this legislation an attempt was made last year to obtain the gift of some five acres of the State's domain in the deep-water of Charles River, to be used as terminal grounds for railroads.

This attempt was rendered the more extraordinary from the fact that over an acre of what one party tried to get for nothing was the larger portion of the tract which, by the law of 1861 the legislature had authorized the governor and council to sell in equal portions to the Eastern and Boston and Maine Railroad Companies, and this gift was asked with the knowledge that the Boston and Maine Railroad Company had offered to purchase the whole or the half of this tract adjoining its bridge at two dollars a square foot. At this price the whole parcel was worth \$160,000. At fifty cents per square foot the residue of the five acres would amount to some \$87,000 more, in all about a quarter of a million dollars. If the value were not even half this sum it would be too much to give away.

Moreover, it was well known that the outlet of Charles River was already so obstructed by the pile-bridges now encumbering it, and the velocity of the outgoing stream so accelerated by these obstructions, as well as by the contraction of the outlet of Mystic River that, during a period of twenty-six years,—from 1835 to 1861,—over a million cubic yards of material had moved from one part of the harbor to form a shoal in the harbor elsewhere. The swift current thus produced also operates as a hindrance to the navigation of the river. Still further to accumulate obstructions here is to in-

tensify the action of the causes detrimental to the harbor, and injurious to the navigation of one of its deep-water basins.

Fortunately the legislature refused these applications, although most strenuously pressed upon their attention. It merely authorized one corporation to occupy a small tract of a little over a quarter of an acre by paying for its value, since assessed at fifty cents per foot. These applications were refused by the legislature, but under circumstances that have led the Board to apprehend that they would be renewed again this year, with even a stronger combination of influences to persuade the legislature that it is for the public interest to grant them.

This Board resisted these applications last year, and now renews its objections to them, upon these grounds:—

1. There should be allowed no further additions to the pile-structures at the outlet of Charles River. The policy of the State should be to reduce rather than to increase them and the mischiefs to the harbor and to navigation they entail. It is perfectly feasible to do so. The joint commission of the Harbor and Railroad Commissioners in its report to the legislature of 1871, under chapter 301, section 2, Acts 1870, submitted a plan for giving terminal facilities to the railroads terminating on Charles River, which reduced the twenty and more acres of pile-structures now encumbering the outlet of Charles River to two double-storied bridges of iron. The execution of this plan, or some plan like it, would restore the river and harbor to a normal condition, give the railroads large tracts for occupation on the margins of the stream, obviate the perilous grade crossings of so many intersecting railroad tracks, and restore to commerce one of the deepest, most sheltered and best located basins in Boston Harbor. To carry it out would cost money, but there would be four strong railroad corporations to do it, and in the end it would be found economical.

2. Such gratuitous grants would overturn the true and settled policy of the State, to make the value of its public domain in tide-lands inure to the benefit of the whole people instead of a few favored beneficiaries, and establish the unjust and corrupting precedent, that the Commonwealth holds a

valuable kind of property to give away to such individuals or corporations as ask for it with the greatest urgency.

• In view of these considerations, the Board submit that the time has arrived for the passage of a general law requiring that all parties who shall hereafter be authorized to occupy land of the State in tide-waters shall pay into the treasury of the Commonwealth for the rights acquired, a just and equitable compensation, to be determined by the governor and council. Whatever is occupied for state, county, or municipal purposes would properly be excepted from the operation of this law. The form of such an Act, adjusted to existing legislation, is appended to this Report.

OFFICE WORK.

The following statements show the subjects and localities examined and visited by the engineer; the hearings of parties interested in works and matters connected with the tide-waters of the Commonwealth; the surveys, plans, sketches and reports prepared by the engineer, and the actual licenses granted by the Board. This last item alone of the direct action of the Commissioners in session of the Board shows an increase of duty of over one hundred and fifty per cent., or forty-six plans and works approved, against an average of about eighteen for any one previous year prior to the general law of 1872, before mentioned, vesting the power of acting on these matters in the Board:—

Field-work during the Year 1872.

1. Survey of shoals on the west side of the Boston and Maine Railroad bridge in Miller's River.
2. Survey and examination in Prison-Point Bay for purpose of assessing compensation for tide-water displaced by fillings.
3. Survey on Fort Point Channel for determination of Commissioners' line.
4. Survey at Crow Point, Hingham Harbor, for determination of channel and for wharf extension.
5. Survey of Charles River at Brighton for wharf extension.
6. Survey at Commercial Point to determine channel and division lines of flats.

7. Survey and examination in Salem Harbor for wharf extensions.
8. Survey in Lynn Harbor and at Nahant for the removal of unlawful obstructions, and the reestablishment of monument fixing harbor-lines, also inspection of wharves and solid filling.
9. Survey for the determination of harbor-line in Charles River back of Brimmer Street.
10. Survey for the determination of harbor-line in Miller's River.
11. Survey of works and filling done by Boston and Lowell Railroad Company in Charles and Miller's Rivers.
12. Survey for the determination of line of draw-way openings in Craigie and Lowell freight railroad bridges.
13. Survey of channel-lines and for wharf extension in Salem Harbor and South River.
14. Survey for determining harbor-lines in Neponset River and for sea-walls of Boston Gas Light Company.
15. Survey for determination of low-water and channel-lines in Mystic River.
16. Survey for determination of low-water lines in Weymouth Fore River.
17. Survey for determination of low-water lines in Salem Harbor and for the extension of Washington Street across tide-water by the city.
18. Examination of bridge piers for the extension of Auburn Street in Medford across Mystic River.

Numerous other surveys, sketches and examinations have been made of which no record has been kept.

Hearings before the Board.

One consultation with United States Advisory Council.

One conference with Mayor and citizens of Charlestown.

One hearing of Boston and Lowell Railroad Corporation concerning obstructions in Miller's River.

One hearing of Boston and Maine Railroad Company concerning fillings and deposits in Charles River.

Two hearings on petition of Cook, Jordan & Morse and others concerning wharf and harbor lines in Neponset River.

Three hearings of Henry Breed and others concerning wharf-lines in Lynn Harbor.

Four hearings on petition of George Griggs and others concerning harbor-lines and sea-wall in Charles River.

One conference with J. B. Francis, Esq., concerning drainage of meadows in East Harbor, Provincetown.

One visit of Board to Manchester, and hearing there of county commissioners concerning bridge over tide-water.

One hearing on petition of Boston and Maine and Eastern Railroad Companies concerning the alignment of new draws in Miller's River.

One hearing on petition of county commissioners of Bristol County concerning bridge and draw over Taunton River between Berkley and Dighton.

One hearing on petition of Roxbury Mill Corporation concerning the filling of flats and building sea-wall.

One visit of Board to Provincetown and hearing of parties there concerning draining East-Harbor meadows.

One hearing on petition of D. B. Newcomb and others concerning extension of wharf in Salem Harbor.

Citizens of Lynn appeared at request of Board to answer complaint why they should not be restrained from unlawfully filling flats and building structures in Lynn Harbor.

Boston and Lowell Railroad Company appeared at request of Board concerning filling in Miller's River.

One conference with street commissioners of city of Boston concerning extension of Swett Street across South Bay.

One hearing on petition of Roxbury Mill Corporation concerning harbor-lines in Charles River.

One visit and examination by Board of Boston and Maine Railroad bridges over Mystic River.

Two hearings on petition of Oakes Ames and others concerning revision of harbor-lines in Charles River basin.

One hearing of selectmen of Medford concerning bridge over Mystic River at Auburn Street in Medford.

Four meetings with board of health at state house concerning nuisance in Miller's River.

One hearing of city of Charlestown concerning filling in Canal Street in Prison-Point Bay.

One hearing of A. W. Mooney concerning extending wharf unlawfully in Newburyport.

One hearing of marsh owners of East Harbor, Provincetown and Truro concerning damages, &c.

Two hearings on petition of W. P. Hunt concerning revision of harbor-lines in Fort Point Channel.

Two hearings on public notice concerning establishment of harbor-lines in Mystic River.

One hearing on public notice concerning establishment and revision of harbor-lines in Charles River basin.

Maps and Plans.

Maps for annual report and tracings for engravers' use.

One plan showing proposed bridge across Lagoon Pond in Vineyard Haven.

One plan showing channels and flats in Hingham Harbor.

One plan showing shoaling on west side of Boston and Maine Railroad bridge in Charles River.

One large map showing water-face of city and suburbs, including Mystic River, Charles River, Miller's River, Fort Point Channel and South Bay.

One large map of Wareham River, showing harbor-lines, for legislature:

One plan showing area of flats in Miller's River for dredging.

One large map showing elevation of proposed new bridge across Mystic River between Charlestown and Chelsea in connection with Mystic River Railroad Company, for legislature.

Four plans showing wharf extensions in Provincetown Harbor.

Three plans accompanying license of Boston Gas Light Company in South Bay.

One plan showing dredging by Gas Light Company in Lynn Harbor.

One plan showing channel and low-water lines in Neponset River.

One large plan of upper basins of Miller's River, for joint commission of Harbor and Health Boards.

Two plans of Charles River basin above West Boston Bridge.

One plan, copy of Baldwin's survey of 1835, showing harbor-lines in Charles and Miller's Rivers.

Two plans accompanying license to city of Somerville, showing filling for upper basins of Miller's River above Medford Street.

In addition to the above a large amount of work has been done in tracings, copies, sketches, &c., of minor matters, concerning which no record has been kept.

Plans approved by the Board of Harbor Commissioners during the year 1872, for the erection of structures in or over Tide-water.

1. Fitchburg Railroad Company, for the erection of a coal-elevator on their wharf in Charles River. Approved January 3, 1872.
2. Falmouth Heights Land and Wharf Company for an extension of their wharf on the south shore of the town of Falmouth. Approved March 2, 1872.
3. F. M. Freeman for the erection of a wharf in Cape Cod Harbor. Approved March 13, 1872.
4. Boston & Maine Railroad Company for the widening of their bridge over Charles River. Approved March 30, 1872.
5. John Ghen and Edward T. Starr, for the construction of a wharf in Cape Cod Harbor. Approved March 30, 1872.
6. Fitchburg Railroad Company for additional piles to be driven to strengthen the foundation of a coal-elevator. Approved April 2, 1872.
7. Roxbury Gas Light Company, for the erection of a seawall in front of their land in South Bay. Approved April 22, 1872.
8. Samuel Downer, for the construction of a wharf at Downer's Landing, Hingham Harbor. Approved May 1, 1872.
9. Butchers' Slaughtering and Melting Association, for the construction of a wharf in Charles River, in the town of Brighton. Approved May 4, 1872.

10. Brine & Clark, for the extension of their wharf in Miller's River, East Cambridge. Approved May 22, 1872.
11. Nathaniel Winsor, for the extension of Curtis's Wharf, Boston Harbor. Approved May 27, 1872.
12. Henry L. Pierce, for the construction of a bridge over Neponset River, at Milton Lower Falls. Approved May 22, 1872.
13. City of Chelsea, for repairing old and constructing new draw piers on Chelsea Bridge, at the mouth of Mystic River. Approved May 22, 1872.
14. City of Boston, for widening and constructing new draws in Federal Street Bridge. Approved May 22, 1872.
15. Boston Gas Light Company, for the construction of a sea-wall in Neponset River, at Commercial Point. Approved June 1, 1872.
16. Katama Land Company, for the construction of a wharf in the harbor of Edgartown. Approved June 28, 1872.
17. Charles A. Ropes, for building a pile-structure in Salem Harbor. Approved July 6, 1872.
18. C. H. & T. W. Beckford, for extension of their wharf in Salem Harbor. Approved July 6, 1872.
19. Ephraim Ryder, for the construction of a wharf in Cape Cod Harbor. Approved July 17, 1872.
20. Hood, Swift & Company, for the construction of a wharf in Chelsea Creek, Boston Harbor. Approved July 31, 1872.
21. Boston Gas Light Company, for the construction of a sea-wall in front of their land, in Boston, near Charles River Bridge. Approved July 19, 1872.
22. L. A. Smith & Company, for the construction of a wharf in Salem (North River). Approved July 31, 1872.
23. Samuel G. Snelling, for the construction of a pile-wharf in Neponset River, Boston. Approved July 31, 1872.
24. City of New Bedford, for leave to dump material in some place in the Harbor of New Bedford. Approved August 22, 1872.

25. D. B. & J. Newcomb, for the extension of their wharf in Salem Harbor. Approved September 11, 1872.
26. George Griggs, Thomas Doane, James S. Whitney and John C. Hoadley, for the construction of a sea-wall in front of their flats in Charles River. Approved August 30, 1872.
27. Edward Atkinson and Charles H. Heath, for the construction of a sea-wall in front of their flats in Charles River. Approved August 30, 1872.
28. Boston and Roxbury Mill Corporation, for the construction of a sea-wall in front of their flats in Charles River. Approved August 30, 1872.
29. Frederic and William Tudor, for the construction of a wharf in Nahant. Approved September 25, 1872.
30. Proprietors of T Wharf, for the extension of their wharf on the south side. Approved September 18, 1872.
31. City of Boston, for leave to drive additional piles on the northerly side of Winthrop Bridge. Approved October 2, 1872.
32. T. A. Newhall, for an extension of his wharf in Lynn Harbor. Approved October 9, 1872.
33. Mayor and Aldermen of the city of Somerville, for leave to fill the upper basins of Miller's River. Approved October 25, 1872.
34. Alden Choate, Jonathan Blaney, William R. Blaney and Lucy E. Rowe, for the extension of their wharf in Lynn Harbor. Approved October 30, 1872.
35. Commercial Wharf Corporation, for leave to extend their wharf on the south side. Approved November 20, 1872.
36. John B. Lamper, for the extension of his wharf in Lynn Harbor. Approved November 27, 1872.
37. Boston Gas Light Company, for the construction of a sea-wall in Neponset River at Commercial Point. Approved November 27, 1872.

38. City of Salem, for the extension of Washington Street over South River, Salem Harbor. Approved November 27, 1872.
39. Henry Breed, for the extension of his wharf in Lynn Harbor. Approved December 4, 1872.
40. Eastern Railroad Company, for the construction of a new draw in their railroad bridge over Charles River. Approved December 5, 1872.
41. Eastern Railroad Company, for the construction of a new draw in their railroad bridge over Miller's River. Approved December 11, 1872.
42. Proprietors of Rowe's Wharf, for leave to cover the upper end of their south dock with a pile-structure. Approved December 12, 1872.
43. North, Merriam & Company, for leave to build a cooper's shop in the upper basin of Miller's River below Medford Street. Approved December 18, 1872.
44. Eastern Railroad Company for, leave to widen their bridge over Charles and Miller's Rivers on the westerly side. Approved December 18, 1872.
45. Commissioners on Charles River and Warren Bridges, for constructing a new draw in Warren Bridge. Approved December 11, 1872.
46. City of Salem, for leave to construct a culvert and seawall on the extension of Washington Street over South River. Approved December 19, 1872.

CONCLUSION.

The Board in conclusion expresses its grateful acknowledgment of the valuable coöperation of its U. S. Advisory Council, still consisting of Rear-Admiral Charles H. Davis, Gen. A. A. Humphreys, Chief of U. S. Engineers, Prof. Benj. Peirce, Superintendent of the U. S. Coast Survey, and Prof. Henry Mitchell, of the U. S. Coast Survey. It is under especial obligations to the Superintendent of the U. S. Coast Survey, for the courteous promptness with which the great resources at his command, individual as well as official,

are brought to the solution of difficult questions upon which the Board is continually called to act or advise. To his department the Board is also indebted for the almost constant services of Prof. H. L. Whiting, one of his ablest assistants.

JOSIAH QUINCY,
DARWIN E. WARE,
F. W. LINCOLN,
J. N. MARSHALL,
W. T. GRAMMER,

Board of Harbor Commissioners.

Boston, January 21, 1873.

APPENDIX.

MEMORIAL TO CONGRESS,

CONCERNING THE PROTECTION AND IMPROVEMENT OF BOSTON HARBOR.

To the Senate and House of Representatives of the United States in Congress assembled.

The undersigned, Harbor Commissioners of the State of Massachusetts, authorized by law to apply to Congress for appropriations for protecting and improving any harbors in the Commonwealth, respectfully represent:—

That this Board soon after its organization in 1866, entered upon a study of the difficulties presented to navigation in the channels of Boston Harbor, and of the causes which increased some of these difficulties from year to year; and finally, in a petition to Congress, early in the year 1867, enumerated the points at which it was deemed very desirable that persistent efforts should be made to remove existing obstructions, and to defend important headlands from the further attacks of the sea;

That Congress regarded these projects with favor, and made appropriations from year to year, at first quite liberally; but recently in a more sparing manner than the importance of the work and its successful and economical progress would seem to warrant;

That these appropriations in the judgment of this Board have been wisely and carefully expended, securing decided advantages to navigation and promising complete and early success in the realization of all our hopes, if the work in future can be supported as liberally as in former years;

That the special attention of Congress should again be given to the works in progress and those within the scope of the original plan of improvement, as detailed below.

§ 1. *The Upper Middle Bar* is a natural barrier of clay and bowlders, which crosses the main ship-channel just within the entrance to the Upper Harbor. Before excavations were commenced there were only about eighteen feet of water on the most depressed portions of this bar at low-tide; so that vessels of war and heavy merchantmen were obliged to wait for the rise of the tide

before venturing into the basins above. The project upon which appropriations have thus far been made contemplates a channel of the same width as that designed for the narrows below, viz., 600 feet. The U. S. Engineer reports a through cut already executed, forty feet in width, and a partial cut 1,040 feet in length reaching the full depth required. These operations have demonstrated the entire feasibility of the improvement, and if Congress will afford the means estimated by the U. S. Engineers, the port of Boston will soon be in a condition to guarantee the heaviest vessels in the world against any material delay, a result directly beneficial to the general government, because of the navy-yard, which can only be reached by way of this channel, and of incalculable importance to our commerce with foreign nations.

§ 2. The sea-wall on Long Island Head was one of those works which we urged in our petition of 1867 as a provision against the encroachments of the sea, which threatened the harbor with an increase of exposure and the creation of dangerous shoals. Two-thirds of the projected wall have already been built and there remain only 540 feet to be provided for. Since the government has commenced to build fortifications upon this headland the wall becomes a still greater necessity than before.

§ 3. The sea-wall at Point Allerton, designed to be 1,180 feet in total length, has been completed within 253 feet and has realized expectation thus far. The engineer, General George Thom, reports that he can easily finish this work during the coming season if the means are supplied. Point Allerton has been called “the *pierhead* of the natural mole that defends the lower roadstead.” It needs but a glance at the chart of Boston Harbor, to impress one with the importance of preserving this point, which is at once a landmark and a shelter.

§ 4. The masonry upon the sea-wall of Gallop’s Island is finished, and all that is required to complete the work at this place is proper grading behind the wall and a deposit of stones for an aproning in front.

§ 5. Other works of completion and repairs referred to by the U. S. Engineer are also deemed essential by this Board, and recommended to a favorable consideration.

Thus far we have referred only to works in progress, for which we trust the amounts necessary for entire completion will be appropriated. There are other works of protection and improvement which we feel constrained to bring to the notice of Congress, most of which were enumerated in our petition of 1867 to which we have already referred. Important among them is the removal of—

§ 6. *Great Brewster Spit*: This shingle mole has been steadily ad-

vancing upon the main ship-channel for a number of years, as if designing to block up ultimately the principal means of approach to the city of Boston. In our petition of 1867, to which we have already referred, we asked that 180 feet, which represented the advance of this mole into the channel during the previous fifteen years, might be dredged away. As we have said, this work was not reached with the appropriation made by Congress in response, and has remained untouched. Meantime the extension, we are informed, has been going steadily on, at about the same rate as formerly, measured superficially, and at *even a greater rate* below the surface. We consider that the removal of the portion of this spit which has advanced upon the ship-channel is a work that can be no longer postponed without serious injury to the main channel at the very threshold of the port; and we earnestly ask that a sufficient appropriation may be made for removing this growing evil.

§ 7. *Widening of Main Ship-Channel at Narrows:* The project for the enlargement of the main ship-channel by the removal of portions of Lovell's Island was never quite completed.

The design, as reflected in Gen. Foster's report of January 9, 1868, was to widen the channel to 685 feet between the eighteen-foot curves, and to dredge to a uniform depth of twenty-three feet at mean low-water. We presume it was designed to extend the twenty-three feet depth as near to the eighteen-foot curves (from which the width proposed was measured) as the proper slope of repose in the material would permit, which slope would perhaps be 1 : 5.

Gen. Foster in his final report concerning this matter, dated January 10, 1871, states that "this improvement has widened the channel at this point, at the depth of the eighteen-foot curves, from its former width of 365 feet to 625 feet, a gain of 260 feet."

While the above statement is correct as a rule, and the improvement is one of very great benefit, nevertheless there are some outlying lumps that have not been swept away by the current, as Gen. Foster presumed they would be. Moreover, as indicated by the aforesaid report, the original design for widening the twenty-three-foot channel-way has not been fully realized.

§ 8. *Nash's Rock:* This is a serious obstruction, in the entrance to Boston Harbor, one-third of the way over from Brewster Spit to Point Allerton. The depth of water upon it, thirteen feet at low-tide, is scarcely sufficient to permit a heavy ship to go over it at the top of the tide; so that it is always a source of alarm, and vessels to avoid it make such a sheer to the southward that they are in danger of running upon the "Centurions," a group of rocks on the other side of the channel further up.

Two or more vessels are reported to have struck Nash's rock during the past year, and its removal would be highly gratifying to shippers and seamen.

§ 9. *State Rock*: Since the injury and detention of the steamer Norman, which struck on this rock some time since, there has been a growing desire among pilots and seamen to have this obstacle removed. It appears upon the Coast Survey Chart of 1857 at the elbow on the south side of the Lower Middle Shoal marked by buoy No. 8.

§ 10. *Palmyra Rock*: The exact position of the rock upon which the Cunard steamer Palmyra struck, about a year since, is unknown to this Board. A search for this rock and its removal, if in the pathway of commerce, would be a valuable work.

JOSIAH QUINCY.
DARWIN E. WARE.
F. W. LINCOLN.
J. N. MARSHALL.
W. T. GRAMMER.

REPORT OF GENERAL GEORGE THOM,

UNITED STATES ENGINEER

ON GOVERNMENT WORK IN BOSTON HARBOR AND ELSEWHERE IN
NAVIGABLE WATERS OF MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE, }
BOSTON, MASS., Jan. 1, 1873. }

Brigadier-General A. A. HUMPHREYS, *Chief of Engineers U.S.A., Washington, D. C.*

GENERAL:—I have the honor to submit the following report of operations during the six months ending December 31, 1872, on the several works in progress for the

Preservation and Improvement of Boston Harbor, Massachusetts.

These works consist of the following, viz.:—

1. Sea-wall, for the protection and preservation of Point Allerton.
2. Sea-wall, for the protection and preservation of Gallop's Island.
3. Sea-wall, for the protection and preservation of Long Island Head.
4. Completion of the removal of Kelly's Rock; and
5. Deepening the channel (by dredging) through the Upper Middle Bar.

Sea-wall on Point Allerton.—Work upon this wall was commenced in September, 1870, under a contract made May 24, 1870, with Mr.

James M. Andrews, and was carried on under that contract until the first of June, 1871, when the appropriation under which that contract was made became exhausted. The work was thence continued under the new appropriation of March 3, 1871, with hired labor and machinery, until the 20th of August, 1871, when it was continued under a contract made the 26th of July, 1871, with Mr. James M. Andrews, the former contractor, the work on this contract having been completed on the 31st of December, 1871. Owing to the exhaustion of the appropriation made for the improvement of this harbor, operations were suspended upon this sea-wall until the 1st of September, 1872, when it was resumed by the former contractor under a new contract, dated August 24, 1872. Under this contract, which was completed on the 30th of November, the following work has been done, viz.:—

237 $\frac{1}{10}$ linear feet of granite wall (including facing and coping with concrete foundation and backing).

680 $\frac{6}{10}$ cubic yards of excavation for the foundation; and

1,872 $\frac{1}{2}$ cubic yards of backfilling.

The total cost of which work, as per contract, was \$20,086.94.

There now remains to be done, in order to complete this wall to its length of 1,180 feet (as now contemplated):

253 linear feet of wall (i. e., granite facing and coping, concrete foundation and backing).

750 cubic yards of excavation for the foundation of same.

3,200 cubic yards of backfilling; and

1,967 superficial yards of granite pavement.

The estimated cost of which work is (including contingencies) \$40,000.00.

This work could easily be completed in one season, should the appropriation be made large enough for that purpose.

Sea-wall on Gallop's Island.—Work upon this wall was commenced in the year 1868, under a contract made May 26, 1868, with Mr. James M. Andrews, of Biddeford, Me., and was carried on under that contract until the end of April, 1871; after which it was continued, with hired labor and machinery, up to the latter part of September, 1871, since which time operations have been suspended. There remains to be done, for the completion of this work, about 5,000 cubic yards of grading on the bluff in its rear; and a stone apron-work made for the protection of a portion of this wall, the estimated cost of which is, say \$5,000.00.

Sea-wall on Long Island Head.—The construction of this wall was commenced in August, 1870, under a contract made May 14, 1870, with Mr. James M. Andrews, and was carried on under that contract, until the 1st of June, 1871, when the appropriation under which the contract was made became exhausted. The work was thence continued under the appropriation of March 3, 1871, with hired labor and machinery, until the 21st of August, 1871; after which it was continued, under a contract made July 26, 1871, with Mr. James M. Andrews, until the middle of May, 1872, when his contract was completed. Owing to the exhaustion of the appropriation made for the improvement of this harbor, operations were suspended upon this sea-wall until the 1st of September, 1872, when they were resumed by the former contractor, under a new contract, dated August 23, 1871. Under this contract (completed November 30, 1872), the following work has been done, viz.:

328 $\frac{2}{3}$ linear feet of granite wall (including granite facing and coping, with concrete foundation and backing).

901 $\frac{71}{100}$ cubic yards excavation for the foundation; and

1,494 $\frac{5}{8}$ cubic yards backfilling.

The total cost of this work, as per contract, was \$20,773.03.

There now remains to be done, in order to complete this wall to its contemplated length of 2,100 linear feet:

540 linear feet of wall (i. e., granite facing and coping, with concrete foundation and backing).

1,485 cubic yards of excavation for the foundation.

4,000 cubic yards of backfilling; and

3,460 superficial yards of granite pavement.

The estimated cost of which work is (including contingencies), say \$60,000.00.

Kelly's Rock.—In 1869 and 1870, this sunken ledge was broken up and removed to a depth of 23 feet at mean low-water, with the exception of a few projecting points, which still have but 21 $\frac{1}{2}$ feet of water over them, which it is contemplated to remove early next season.

The estimated cost of this work is \$500.00.

Upper Middle Bar.—The contemplated plan for the improvement of this bar, consists in the excavation of a channel through it, to a width of 600 feet, and to a depth of 23 feet at mean low-water—the

average length of the projected cut being 2,200 feet. The depth of the excavation will vary from one to seven feet.

Under a contract made May 24, 1870, with Mr. Emory R. Seward, of Albany, New York, dredging was carried on at this bar until June 1, 1871, when the appropriation under which the contract was made became exhausted,—26,120 cubic yards having been excavated under that contract, whereby one cut was partially opened to a width of 45 feet, and to a depth of from 20 to 23 feet at mean low-water; some progress was also made on a second cut.

Under the appropriation of March 3, 1871, a new contract was made July 29, 1871, with Mr. R. G. Packard of Brooklyn, N. Y. This contract was completed on the 29th of June, 1872, by the excavation of 20,305 cubic yards; making the total quantity of excavation to that date, 46,425 cubic yards.

In July, and again in September, 1872, proposals were invited for continuing the dredging on this bar, under the appropriation of June 10, 1872; but the proposals received not being satisfactory to me, they were not accepted.

During the dredging operations in May last, a large granite boulder, of about nine cubic yards, was discovered in the middle of the "Upper Middle" channel, having but $16\frac{1}{2}$ feet of water over it at mean low-water. This boulder was removed early in November last, by George W. Townsend, of Boston, under his contract of August 31, 1872.

The work thus far done upon this bar, consists in the excavation of one cut 40 feet in width, and 1,800 feet in length, through the whole length of the bar, and the partial completion of a second cut for a length of 1,040 feet, to a depth of 23 feet at mean low-water.

To complete this channel to the contemplated width of 600 feet, will require about 230,000 cubic yards of dredging, the cost of which, including contingencies, is estimated at \$190,000.00.

In addition to the operations above reported, a very accurate resurvey has been made of "The Narrows," in the vicinity of Gallop's Island, Nixmate, George's Island, Lovell's Island and Great Brewster Bar, in order to ascertain what changes, if any, have taken place since the widening of the channel and the completion of the other improvements in that vicinity. A report on this resurvey will be submitted as soon as the drawings are completed.

In the month of December an examination was made of the wreck of the Schooner "Delos," near Fort Warren wharf; and a report was submitted, with an estimate of the probable cost of its removal, amounting to \$1,000.00.

The following is a recapitulation of the estimates of the cost of completing all the works above named, viz.:—

1. Sea-wall on Point Allerton,	\$40,000 00
2. Sea-wall on Gallop's Island,	5,000 00
3. Sea-wall on Long Island Head,	60,000 00
4. Completion of the removal of Kelly's Rock,	500 00
5. Completing the channel, by dredging through the Upper Middle Bar, to a width of 600 feet,	190,000 00
6. Removing wreck of Schooner "Delos,"	1,000 00
Total,	<u>\$296,500 00</u>

Unexpended balance of appropriation of June 10, 1872, available for this harbor, December 31, 1872, say \$28,500.

Additional amount required for completing the improvements at present contemplated, \$268,000.

Respectfully submitted, .

GEO. THOM,

Lieut.-Col. of Engineers, Brevet Brig.-Gen. U. S. A.

U. S. ENGINEER OFFICE,)
BOSTON, MASS., January 27, 1873. }

Hon. JOSIAH QUINCY, *Chairman Board of Harbor Commissioners.*

SIR:—I have the pleasure of furnishing, in compliance with the request contained in your letter of the 21st instant, a copy of my report to the chief of engineers, on the several works under my charge, for the improvement of harbors and rivers in the State of Massachusetts, for the six months ending December 31, 1872, as follows, viz. :

I. PRESERVATION AND IMPROVEMENT OF BOSTON HARBOR.

[A copy of this report was forwarded on the 2d instant.]

II. IMPROVEMENT OF MERRIMAC RIVER.

The following appropriations have been made by Congress for the improvement of this river, viz. :—

By Act of July 11, 1870, "for improvement of Merrimac River, Mass.,"	\$25,000 00
By Act of March 3, 1871, "for improvement of Merrimac River, above Haverhill, Mass.,"	25,000 00
By Act of June 10, 1872, "for improvement of Merrimac River, above Haverhill, Mass.,"	25,000 00
Total,	<u>\$75,000 00</u>

Amount expended up to July 1, 1872,	\$49,512 96
Unexpended balance July 1, 1872,	\$25,487 04
Unexpended balance January 1, 1873,	\$25,180 25

The work originally projected for the improvement of Merrimac River, embraced—

1. The removal of obstructions at the Upper and Lower Falls, above Haverhill, so as to have a channel 60 feet wide and 4 feet deep in the lowest stages of the river.

2. The removal of the two Gangway Rocks, near the mouth of the river, in Newburyport Harbor, Mass.

3. The removal of the rocks known as "The Boilers," near the city wharves at Newburyport.

4. The removal of the wreck of the Schooner "Globe," a coal-vessel, sunk at the mouth of the river, near Newburyport light-house.

Up to the first of July, 1872, the following work had been done under the above appropriations, viz. :—

1. The main Gangway Rock in Newburyport Harbor was broken up and removed (in 1870) to a depth of $9\frac{1}{2}$ feet at mean low-water; and a commencement was made in the removal of North Gangway Rock.

2. The removal (in 1870) of the wreck of the Schooner "Globe."

3. The excavation and removal (in 1870) of 475 cubic yards of material, from the channel in the Lower Falls, above Haverhill; and the additional excavation and removal (in 1871) of 2,100 cubic yards of material in those falls, under a contract made May 31, 1871, with Mr. H. S. Fretch, of Boston, Mass. In addition to which a sunken ledge which extended directly across the river at these falls, was partially broken up, ready for removal.

The work done in these falls on the 1st of July, 1872, consisted in the excavation of a channel to a width of 60 feet in the lower portion of the falls, up to where crossed by the sunken ledge; the partial breaking up of the ledge; and some dredging in the channel above the ledge—but not so as to give a continuous channel of the required depth, through the entire length of the falls—the work in these falls being about one-half completed.

4. A resurvey made (in 1871) of the river, from the foot of Hazeltine Rapids up to the locks at Lawrence, a distance of $7\frac{1}{4}$ miles,

including particularly the several rapids and shoals needing improvement.

Under the appropriation made by Act of June 10, 1872, for the improvement of this river "*above Haverhill*," it was decided to complete the channel at the "Lower Falls," as well as at Hazeltine Rapids next below the Lower Falls, to that extent found to be necessary by the resurvey of 1871. Proposals were accordingly invited for this work, for which two were received on the 6th of September, the lowest being that of Mr. Augustus R. Wright, of Geneva, N. Y., for doing the required dredging, at \$4 $\frac{9.5}{100}$ per cubic yard, as measured in the scows. On the 9th of September a contract was made with Mr. Wright for this work—to be commenced as soon thereafter as practicable, and to be completed on or before the 30th of June, 1873. Owing to the frequent and heavy rains which continued throughout the remainder of the season, the river was raised to such a stage, as to have been impracticable for this work in "the falls"; so that no work has thus far been done under this contract.

The following is an estimate, as modified by the resurvey of 1871, of the cost of the improvements now projected for the improvement of the river, both in the harbor of Newburyport and above Haverhill, viz.:—

1. Completing the removal of North Gangway Rock in Newburyport Harbor, 700 cubic yards, at \$20,	\$14,000 00
2. Removing "The Boilers" near the city wharves, in Newburyport Harbor,	6,000 00
3. Excavating a channel 60 feet in width and 4 feet in depth, in the lowest stages of the water, at Hazel- tine Rapids, 1,900 cubic yards, at \$5,	9,500 00
4. Completing the channel to same width and depth at the "Lower Falls," 2,500 cubic yards, at \$5, . .	12,500 00
5. Excavating a channel to same width and depth at the "Upper Falls," 6,500 cubic yards, at \$5, . . .	32,500 00
Engineering expenses and other contingencies, say	7,680 25
Total,	\$82,180 25
Amount available January 1, 1873,	25,180 25
Additional amount required for completing all the im- provements, as now contemplated,	\$57,000 00

Survey of Merrimac River, Massachusetts, from Haverhill to Newburyport, including Duck Hole and Currier Shoals.

This survey was called for by Act of Congress approved June 10, 1872, "making appropriations for the repair, preservation and completion of certain public works on rivers and harbors, and for other purposes"; and was made in August and September, 1872, by Lieut. James B. Quinn, U. S. Corps of Engineers, under my instructions.

The object of this survey was to ascertain what, if any, ledges, bowlders, shoals or other obstructions exist to impair the navigation of this river between "the falls" in Haverhill and the mouth at Newburyport, and to determine the nature and extent of such obstructions, with the probable cost of their removal. These obstructions are described in Lieut. Quinn's report; and his recommendations to so improve the river as to permit vessels of 20 feet draft to ascend to Amesbury Ferry, and vessels of 11 feet draft thence up to Haverhill, have my approval.

The cost of these improvements as estimated by me, is as follows, viz. :—

1. Removal of Gangway Rock, No. 3, 14 cubic yards,	
at \$20,	\$280 00
2. Removal of two rocks above Deer Island Bridge, 108	
cubic yards, at \$20,	2,160 00
3. Removal of Rocks at Rocks Bridge,	1,000 00
4. Removal of Little Currier Rock, 2 cubic yards, at	
\$12 $\frac{50}{100}$,	25 00
5. Dredging at Currier Shoals, 6,500 cubic yards, at	
75 cents,	4,875 00
6. Dike at Silby's Head, 350 feet, at \$25,	8,750 00
Adding for contingencies, say,	2,910 00
Total,	<hr/> \$20,000 00

III. REMOVING ROCKS IN GLOUCESTER HARBOR.

By an Act of Congress approved June 10, 1872, there was appropriated "for removing rocks in Gloucester Harbor, Mass.," the sum of \$10,000. This appropriation is to be applied to the removal of the several rocks, named as follows, viz. :—

1. *Babson's Ledge.*—This ledge is about 800 feet south-west from Fort Point. It has about 18 feet of water upon it at mean low-water; is covered for the greater part with bowlders of various sizes, from small shingle wedged in between the bowlders, up to pieces of

twenty and more tons, some of which have less than 13 feet of water over them at mean low-water. Between the 18-foot curves, its extreme length is 260 feet, and its greatest width is 178 feet, with an area inside of 3,000 square yards. It is required to obtain a depth of 18 feet of water over this ledge at mean low-water, which will necessitate the removal of 670 yards (more or less) of bowlders and ledge.

2. *Clam Rock*.—This rock is situated near the entrance of Harbor Cove; is a round clam-shell shaped head, cropping out from a solid ledge of coarse, dark-colored granite. Its length is 15 feet, and average width $11\frac{1}{2}$ feet; it has one foot of water over it at mean low-water, and rises 8 feet above the bottom surrounding it; and contains about 30 cubic yards above the plane 9 feet below mean low-water, to which depth it is required to be removed.

3. *Pinnacle Rocks*.—These rocks consist of several bowlders, about 500 feet to the eastward of Clam Rock, the largest of which rises 8 feet 4 inches above its surrounding bottom of soft mud, in which it is imbedded to a depth of from 1 to $1\frac{1}{2}$ feet, and has $8\frac{3}{16}$ feet of water over it at mean low-water. It measures 16 feet in length by an average width of 14 feet, and is 9 feet 8 inches high—containing $54\frac{1}{2}$ cubic yards. The smaller bowlders near it (which form, with the large one, the so-called “Pinnacle Rocks”) contain 24 cubic yards (more or less) additional—altogether making $78\frac{1}{2}$ cubic yards (more or less) of bowlders to be removed.

4. *Rock off J. Friend's Wharf*.—This rock is the cropping out of a granite ledge, and is 4 feet above the surrounding bottom. It measures 22 feet in length by 12 feet in width, and has 13 feet of water over its top at mean low-water—requiring the removal of 22 cubic yards (more or less) in order to obtain the required depth of 17 feet below mean low-water.

5. *Rock off Pew's Wharf*.—This is a small granite boulder containing 3 cubic yards, lying in about five feet of water at mean low-water.

The contents of the above-named rocks are as follows, viz.:—

1. Babson's Ledge	.	.	contains 670 cubic yards, more or less.
2. Clam Rock	.	.	“ 30 “ “ “ “
3. Pinnacle Rocks	.	.	“ $78\frac{1}{2}$ “ “ “ “
4. Rock off J. Friend's Wharf	.	.	“ 22 “ “ “ “
5. Rock off Pew's Wharf	.	.	“ 3 “ “ “ “
Total.			803 $\frac{1}{2}$ cubic yards, more or less.

Proposals were invited for this work, and on the 26th of August, 1872, a contract was made with Mr. George W. Townsend, of Boston, Mass., for removing, at \$15 per cubic yard, Clam Rock, Pinnacle Rocks, Rock off J. Friend's wharf and Rock off Pew's wharf: also for removing, at \$20 per cubic yard, about 375 cubic yards of the largest bowlders on Babson's Ledge.

About the middle of November, Mr. Townsend commenced operations under his contract, with a diving-party, vessel and crew specially adapted to this kind of work; but on account of the breaking out of small-pox on the vessel, the crew and vessel were placed in quarantine, with the expectation of resuming work early in December, when the disease again broke out and caused a suspension of operations for the winter. Under these circumstances the time for the completion of this contract has been extended, by authority from the department, until the 30th of June, 1873.

Unexpended balance available January 1, 1873. \$9,791.30, which is sufficient for the removal of such rocks as are now deemed necessary.

IV. IMPROVEMENT OF DUXBURY HARBOR.

The surveys recently made with a view to the improvement of this harbor, show that the only part of it, to the improvement of which it would be advisable to give attention, is that known as Miles' Channel or (South Channel). This channel extends from the "Cow Yard" so called, up in a north-westerly direction between Kingston Flats and Captain Flats, passing about 800 feet to the southward of Captain's Hill, to near the new wharf extending out from the south-western shore of Captain's Hill,—a total distance of about three miles. It has a width of not less than 200 feet with $11\frac{1}{2}$ of water at mean low-water (or about 21 feet at mean high-water) for a distance of $2\frac{1}{2}$ miles, i. e. from the "Cow Yard" to the "Spit" projecting in a south-westerly direction from the southern point of Captain's Hill: and from this "Spit" upwards in the remaining half mile it becomes narrow and crooked, having a width of not more than 80 feet for a depth of eight feet at mean low-water. This upper half mile of the channel, which is the only portion that needs improvement, is obstructed by the "Spit" referred to, and more especially by "Splitting-Knife Bar:" and it is now contemplated with the approval of the department, to so straighten and enlarge this channel in those places, as to have a width of 250 feet for a depth of 8 feet at mean low-water. This will require about 45,000 cubic yards of dredging, the material being for the most part fine sand and some mud.

An examination made in July, 1872, of Duxbury (outer) Beach

showed that the government work done there several years ago for the preservation of that beach and consequently of the harbor which is formed and sheltered by it has greatly strengthened and otherwise benefited the beach. There are, however, several depressions of from 12 to 15 inches on the beach between High Pine Hill and Plum Hill, which it is advisable to strengthen with brush-work.

The estimated cost of the work thus projected for the improvement and preservation of this harbor is as follows, viz :—

1. Dredging in Miles' Channel 45,000 cubic yards	
at fifty cents (the price now contracted for),	\$22,500 00
2. Preservation. by brush-work, of Duxbury Beach,	
say,	500 00
3. Contingencies, say,	2,000 00
	<hr/>
Total,	\$25,000 00
Amount appropriated therefor by Act of June 10, 1872,	10,000 00
	<hr/>
Additional amount required for its completion.	\$15,000 00
Amount available January 1, 1873,	9,281 55

It having been decided to apply this appropriation exclusively to the improvement of Miles' Channel by dredging, proposals were *twice* invited for the work before a reasonable and acceptable bid was received, which was that of Mr. Augustus R. Wright, of Geneva, N. Y., for doing the required dredging at fifty cents per cubic yard, as measured in the scows. On the 7th of November, 1872, with the approval of the department, a contract was made with Mr. Wright for this work,—the same to be commenced on or before the 1st of April, 1873, and to be completed on or before the 30th of June, 1873.

In July, 1872, a survey was made of Miles' Channel and Duxbury Beach, a report on which, together with the explanatory drawings, was forwarded to the department on the 6th of August, 1872.

V. IMPROVEMENT OF PLYMOUTH HARBOR.

The work projected for the preservation and improvement of this harbor, consists in the construction and repairs of bulkheads and jetties composed either of stone, or else of timber and brush ballasted with stone, built for the preservation of Long Beach and for its protection from the storms to which it is exposed. This beach serves as a breakwater, and affords to the harbor its only protection from the easterly storms.

The following appropriations have been made by Congress for this work, viz :—

By Act approved July 11, 1870,	\$10,000 00
By Act approved March 3, 1871,	10,000 00
By Act approved June 10, 1872,	2,500 00
<hr/>	
Total,	\$22,500 00
Amount expended therefore up to July 1, 1872,	19,235 32
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Unexpended balance up to July 1, 1872,	\$3,264 68
Amount expended during the six months, ending	
December 31, 1872,	2,523 62
Amount unexpended January 1, 1873,	741 06

Up to the 1st of July, 1872, the work done upon the bulkheads and jetties is shown on the accompanying sketch. In addition to which a large quantity of beach-grass has been planted at various places above on Long Beach. In the extraordinary gale of November 15, 1871, the strength of the bulkheads and jetties was most severely tested; and very little injury was done thereby, except to that portion of the bulkhead between jetties Nos. 28 and 32, and to jetties Nos. 29 and 30 (as shown on the sketch); but these were not so much injured as to require immediate attention.

In conformity with the project of June 22, 1872, which was approved by the department, work was resumed about the middle of July, 1872, under the appropriation of June 10, 1872, in the repairs on the bulkheads and jetties on Long Beach, and were completed the last of August to the extent then deemed necessary. This work was done by hired labor and with materials purchased in open market and consisted,—

1. In making about 200 linear feet of brush bulkhead and jetties to replace that damaged by the storm in November, 1871.
2. In strengthening the outer part of the bulkhead with 613 tons of stone purchased for that purpose.
3. In making 300 linear feet of single-brush jetties, and 250 linear feet of small stone jetties; and
4. In planting 10,800 hills of beach-grass.

In order to continue the repairs as they may become necessary from time to time there will probably be required for the next season the additional sum of \$3,000.

A resurvey was made in July, 1872, of Long Beach, a copy of which is hereto attached, on which are shown the improvements made thereon up to the present time, as well as the changes in the high and low water lines, that have occurred since the survey of 1870 (made by the Engineer Department), and also since the survey of 1856, made by the U. S. Coast Survey. The great benefit that

has been derived from these improvements since the year 1870,—the year in which the present plan of bulkheads and jetties was commenced—becomes very apparent from an examination of these drawings.

VI. REMOVAL OF ROCKS AT ENTRANCE OF WELLFLEET HARBOR.

A survey of this harbor made in 1871, showed the existence of several sunken rocks at and near its entrance which were dangerous obstacles to its navigation; for the removal of which an appropriation of \$5,000 was made by Act of Congress, approved June 10, 1872.

These works are situated and described as follows, viz.:—

1. *Channel Rock*.—This rock is situated about 2,000 yards to the south-east of Billingsgate Light, and lies in about 12 1-2 feet of water at mean low-water, having only two feet of water over its shallowest part; its greatest dimensions being 20 by 19 feet by 10 1-2 feet in height. It is a hard, gray granite boulder, and contains 92 cubic yards, more or less.

2. *Lobster Rock*.—This rock is situated in mid-channel, about 1,400 yards to the eastward of Billingsgate Light. It is a column-shaped boulder, lying in 18 feet of water, with 4 1-2 feet of water on it at mean low-water: its greatest dimensions being 13 1-4 by 10 1-4 feet, by 14 feet in height, and its contents, 60 cubic yards, more or less.

3. *Lumpfish Rock*.—This rock is a small boulder, 500 yards north-east of Lobster Rock. It lies in 9 feet of water with 3 1-2 feet over it, at mean low-water; its greatest dimensions being 10 by 6 feet by 6 feet in height, and its cubic contents 12 yards, more or less.

4. *Mayo's Rock*.—This rock is situated in mid-channel, 40 feet west of "Buoy No. 7." It is a boulder of pyramidal shape, with 2 7-10 feet of water on its shallowest part, and lies in 8 feet of water, at mean low-water; its greatest dimensions are 13 1-2 by 9 feet by 5 feet in height; and its contents 20 cubic yards, more or less.

5. *Bay Rock*.—This rock is situated about 700 yards to the north-west of Mayo's Rock. It is a wedge-shaped boulder, lying in 6 feet of water, and is awash at low tide. Its greatest dimensions

are 15 by 8 feet by 9 feet in height and its contents 20 cubic yards, more or less.

Proposals were invited for this work ; and on the 23d of August, 1872, a contract was made with Mr. Samuel Dyer, of Truro, Mass., the lowest of five bidders, for their removal, at the following prices, to wit :—

1. Channel Rock,	\$850 00
2. Lobster Rock,	750 00
3. Lumpfish Rock,	400 00
4. Mayo's Rock,	450 00
5. Bay Rock,	550 00
<hr/>	
Total,	\$3,000 00

The contractor commenced operations in September, and continued up to the middle of October, when, owing to the continuous stormy weather, he was compelled to suspend work until spring. During that time Channel Rock and Bay Rock were much shattered, nearly ready for removal. With the approval of the department the time for completing this contract has been extended until the 1st of June, 1873.

Unexpended balance of appropriation, available January 1, 1873, \$4,639.60.

VII. IMPROVEMENT OF PROVINCETOWN HARBOR.

The work done up to the 1st of July, 1872, for the preservation and improvement of this harbor was as follows, viz. :—

1. Bulkheads and jetties of various descriptions had been built from time to time along Beach Point, for its preservation and protection, both by the United States Government and by the local authorities.

2. A dike was built in 1868 and 1869 by the State of Massachusetts across the outlet of "East-Harbor Creek."

3. A dike was built in 1868 and 1869 by the United States Government across "East-Harbor Creek." at the "Wading Place." near "High Head," about two miles above the outlet of the creek.

4. Wooden bulkheads and jetties had been built at different times for the protection and preservation of the beach on Long Point.

5. A stone bulkhead had been commenced for the protection and preservation of the outer end of Long Point, opposite the lighthouse and the "Three-gun Battery."

6. A substantial dike (272 feet in length) built in 1871-2 across the head of Lancy's Harbor, near Abel Hill.

7. Beach-grass planted on Beach Point, Long Point, Abel Hill, Cove Section and Oblique Section ; and at the last two places brush had also been laid for their further protection ; and

8. Accurate resurveys made in 1872 of Cove Section and Oblique Section, together with elaborate soundings and current observations in the inner harbor, with a report thereon.

Of the several appropriations made for this harbor there was, July 1, 1872, an unexpended balance of \$5,984.43.

In conformity with my project, dated June 25, 1872, this amount has been applied as follows, viz. :—

1. To the extension of several jetties on Beach Point and the State Dike between 52 and 71, and thence to 90 (as shown by the red lines on the accompanying sketch), in all 660 linear feet ; and to rebuilding 20 linear feet of bulkhead on the State Dike.

2. Six hundred and thirty tons of rubble-stone have been deposited on Long Point, in front of the “Three-gun Battery,” making 123 additional linear feet of bulkhead ; and 135 tons of scattered stone in front of the lighthouse on Long Point have been removed into a line with the new bulkhead, thereby still further increasing its length 20 linear feet. This stone bulkhead is about 7 feet in height and 30 feet wide at its base.

3. About 8,000 hills of beach-grass planted on Beach Point.

4. Repairs made where most necessary on the bulkhead and jetties and the State Dike, and on Beach Point.

This work has all been done by hired labor with materials

purchased in open market ; the cost of which, during

the six months ending December 31, 1872, was, . . . \$5,685 44

Unexpended balance January 1, 1873, 298 99

Additional amount required for completing the work now

projected for this harbor, 10,000 00

VIII. SURVEY OF THE CHANNEL AND BANK AT ENTRANCE OF SALEM HARBOR.

This survey was provided for by Act of Congress approved June 10, 1872, “making appropriations for the repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes” ; and was made, under my instructions, in August last, by my assistant, Mr. Sophus Haagensen, civil engineer. His report and map of the same, also prepared under my direction, have been forwarded to the department, with my approval of the proposed plan of improvement, the estimated cost of which is as follows, viz. :—

1. For excavating a channel 1,730 feet long, 300 feet wide, and 8 feet deep at mean low-water (17.3 feet at mean high-water) from deep-water to the entrance of South River, including contingencies, \$31,000 00
 2. For constructing a sea-wall and a breakwater for the protection of Long Point (including contingencies), 23,000 00
-
- Total cost of improvements, \$54,000 00

Very respectfully,

Your obedient servant,

GEO. THOM,

Lieut.-Colonel of Engineers, Brev. Brig.-General, U. S. A.

REPORT OF GENERAL H. W. BENHAM,
ON PROPOSED WORK ON SEA-WALLS IN BOSTON HARBOR.

BOSTON MASS., September 10, 1872.

GENERAL:—I have the honor to make the following report in relation to the sea-walls of the Great Brewster Island, of Deer Island, and of Lovell's Island, all in this harbor, for the year ending June 30, 1872.

The Great Brewster Island walls, I am gratified to be able to state, are in good condition throughout, and, as they were represented last year, affording efficient protection to the bluffs of this island, while the general arrangement and direction of their terminations is such that there has been no essential abrasion to old level-drift portions of the island.

All of the buildings (except the old boarding-house I had erected there in 1849), together with the wood or pile portion of the wharf, have been removed for reconstruction for the uses of the batteries at Long Island Head, as previously reported. No funds appear to be required at present, and none are now asked for this work.

As to the three sea-walls protecting the three bluffs of Deer Island, I would report them as in essentially good condition, especially in the parts that had been rebuilt. A few defects are found by the falling or drawing out of the foundation-stones, even in some cases on the parts rebuilt, by their not having been taken up to the lowest foundation-course, and by a greater force of the current or waves along these foundations than appears to have existed before, but most of them are reparable without great expense. But for the reconstruction of certain additional portions of north-

head wall with mortar and concrete backing, and providing additional stone for pile-jetties along this wall for its permanent security (though not of immediate pressing necessity), I would respectfully repeat the recommendation in my report of September 6, 1870, and of August 30, 1871, that there should be appropriated the sum of \$18,000.

In relation to the sea-walls at Lovell's Island, I would respectfully report that the sea-wall on the south-east side, or on the east main bluff, erected in 1869-70, is in as perfectly good condition as the day it was finished, as to all parts, its foundation, jetties, coping, paving, &c.; and the position and lines of the work, even with its low relief of 10 feet, including foundation, are such that there is no abrasion of the bluff in rear or at the ends, or scarcely a variation in the level of the shingle-drift of six inches from the joint of the two lower courses of stones above the foundation.

And I would state that the old sea-wall of Ram Head is also in good condition, in its mainly exposed part; the repairs applied to its foundation there two or three years ago appearing to answer the purpose perfectly, and, except a slight displacement of the stones of the west jettee and extremity of the wall, it appears perfectly to answer its design for the protection of the remains of Ram Head. Immediately south of and adjacent to this west termination of the Ram-Head wall there is, however, the continued abrasion to the shore, as stated in my reports of September 1, 1870 and 1871; this extends some eighty yards with a deeply-indented curve of shore-line drift, with a narrow ridge of shingle, on the top of which the surf-deposits of the recent storms are now resting, the sea having even passed over to flood a portion of the island between the Ram Head and main bluff. And it is obvious that any slight additional strength of the waves in a future storm might break through this ridge and force a channel entirely through at the east, between the two bluffs and the sea-wall already built, even if it did not work a passage to the south-east toward the main channel, to its great injury, if not to its destruction.

In view of this danger, I would respectfully repeat my recommendation for a short sea-wall for the extension of the old wall, as also an "apron" protection still beyond it, or farther south upon the water-lines of the shingle-drift, as I had made in the annual reports above referred to for \$15,000.

Respectfully submitted.

H. W. BENHAM,

Colonel of Engineers, Brevet Major-General.

Brigadier-General, A. A. HUMPHREYS, *Chief of Engineers.*

COMMUNICATION OF HON. PELEG W. CHANDLER,
IN RELATION TO THE OCCUPATION OF THE BOSTON SIDE OF THE
CHARLES RIVER BASIN.

The proposed water-park on Charles River has attractive features, and is calculated to excite a good deal of interest. But there are numerous practical difficulties in carrying out the project. As it regards the Boston side of the proposed improvement, these difficulties are very serious. The plan shows a considerable space between the existing lots on Beacon Street and the river. If it be intended to annex this space to these estates it must be, of course, for a large consideration, since there can be no reason why a portion of the river should be filled up for the mere purpose of enlarging and improving the estates on Beacon Street. But there is no probability that the proprietors desire to increase the depth of their lots, which are at present unusually large, and there seems to be no practical use to which the increased extent could be put except for gardens, which in that locality would be of little value on account of its exposed position. If, on the other hand, the intention be to place a row of houses on the new marginal street, and facing the water, it would be difficult to sell the lots for such a purpose, as all who are familiar with the powerful winds in that region must know. On the plan, there is a driveway and rows of trees, but it would be impossible to cultivate trees or shrubs there unless protected from the wind by a high fence, which would obstruct the water-view.

There are legal objections to carrying out this project which it would be tedious to enumerate, but which would embarrass and perhaps ultimately defeat the whole thing, after years of litigation. The greatest objection of all, however, applies to any scheme which involves the diminution of the flow of water in Charles River. The value of this river for sanitary purposes on the western side of a great city is inestimable. An immense body of water coming in from the sea, cooling and tempering the westerly breezes that pass over a large portion of the town, is what few cities in the world can boast of, and is one of those great natural advantages which men of sense are not likely to throw away. I say nothing here of the commercial importance of such a large bridge-locked dock, to construct which would be almost beyond the capacity of human effort, nor of the danger of injuring the whole harbor of Boston by changing the current and diminishing the volume of Charles River.

The question is often asked, What shall we do to improve this water-space? and the answer must always be, having regard to the health, wealth, happiness and comfort of the people, *Let it alone.*

Undoubtedly, however, some measures should be taken in regard to the Cambridge shore, where a marginal street might, perhaps, be laid out to advantage, and where there might be houses and gardens facing the river, inasmuch as it has a southern exposure. and this plan need not necessarily diminish the volume of water in the river to any great extent.

When the Back Bay territory was originally laid out for building purposes a great deal of attention was given to the subject of drainage. Scientific gentlemen, civil engineers and men of practical experience gave the subject their best attention. As the whole territory was in effect rescued from the sea, and the foundation of all structures on it must rest upon piles, it was easy to see that the best method of drainage was a problem of no easy solution. Without going into an explanation of the theories advanced and of the experiments made, it is sufficient to say that the plan which was ultimately adopted was based upon the supposition that Charles River was to remain as it then was, and particularly that the line of filling on the southerly side, which had been solemnly established by covenants between the State and the Boston and Roxbury Mill Corporation, should not be changed. The effect of the farther extending this line into the river, thereby diminishing the body of water and making it necessary to extend the drains, might, and probably would, be disastrous; not indeed affecting the houses on Beacon Street, each one of which drains directly into the river, but disturbing the somewhat complicated *system of drainage* extending over the whole territory. In order to render drainage possible in that locality the houses must be placed at a certain altitude, and, from the nature of the case, the drains have a slight descent, but they can be washed out by the tide. They are constructed upon a regular and scientific system, and they operate in general extremely well; but by increasing their length their efficiency must be greatly diminished. Without further comment upon this point, or going into minute and tedious details as to the system of drainage of the territory, there is no doubt whatever that grave and alarming consequences would result from the adoption of any plan which should considerably diminish the ebb and flow of the tide of Charles River. At any rate it would cause a very general excitement among those who now occupy this territory, and would impede and embarrass, if it did not prevent, a successful accomplishment of the proposed plan.

Many public improvements are rendered difficult and sometimes impossible by three things: First, because they conflict with the legal rights of individuals, and require the assent of various parties who have conflicting interests, or else because embarrassed by tedious litigations; secondly, because they are enormously expen-

sive, and the means required are out of proportion to the expected benefit; thirdly, because they are of an experimental character, and while the injury may be greater than the benefit, things never can be placed where they were before. The proposed water-park seems liable to all of these difficulties. It will be in the power of a single individual to prevent the scheme from being carried to complete success. It will certainly be very expensive: and it is an experiment which may work infinite and irreparable injury to the Back Bay territory and to the harbor itself. No doubt the time has come when it is highly desirable, if not absolutely necessary, to decide on the future character of this territory. But neither the citizens of Boston or Cambridge, or the inhabitants of the Commonwealth generally, will consent to give up this noble bay for the purpose of mis-called improvement in house-lots, driveways and gardens. There is plenty of land in this vicinity for all these purposes, but there is no other Charles River. To call that a water-park, which is constructed by filling up two-thirds of the area of this river is clearly a misnomer.

The erection of houses on the water-side of Beacon Street has been, in some respects, a great improvement, but it is depriving the public of one of the finest promenades in the world. It is true that this road was formerly in a wretched condition. On one side of it was the empty basin, full of the accumulated filth of nearly half a century, and attended with noisome smells which seriously endangered the health of the citizens. On the other side, also, the appearance of things was not altogether agreeable,—a ragged and dirty shore with fierce winds six months of the year. All who used the way were required to pay toll, and the roadway was quite narrow. The efforts which were commenced nearly twenty years ago to rescue this whole territory and render it worthy of our city, were vehemently opposed at every step by interested parties, and were only successful by many compromises. Still, the loss of a grand promenade, from which the whole Back Bay was visible, is a serious one, and will be felt more and more as new buildings are erected. What the public now desire is an unobstructed view of the river, and ample prevention of nuisances therein. So far as a driveway is concerned there is no necessity for any change; persons who ride or drive over Beacon Street can easily find charming and interesting localities in the vicinity of Boston. To such people the fact that there is not an unobstructed view of the river for a mile or two, is not of much consequence. Most of them doubtless prefer the present state of things to that which formerly existed, especially as the Back Bay territory itself furnishes some nine miles of excellent driving. The large mass of people who are unable to ride or drive, and are

compelled to remain in the city through the summer, derive great benefit from the better condition of the atmosphere in consequence of the west winds coming over this great body of water, much greater than those who reside near it, but are out of the city during the hot season. But they also naturally desire—and this feeling will not diminish as the years pass on—to see this river as well as to feel its beneficial effects. The immediate problem, therefore, which it is desirable to solve is, *how to provide a public walk or an esplanade on the water-side.*

The sea-wall on Charles River, parallel with Beacon Street, is one hundred and eighty feet distant therefrom. The lots are one hundred and fifty feet deep. This leaves a space between the lots and the river thirty feet wide, which is owned by the proprietors of the lots, but is open to public use. Now, suppose that an arrangement be made by which a *plank walk should be extended from the sea-wall directly over the river some ten feet wide.* We should ultimately have a promenade of the width proposed and several miles in length, which would be unique in character, convenient of access, and in all respects desirable. Persons passing over the Common, through the Public Garden and Arlington Street, would come immediately upon this fine water-esplanade. It seems to me that this project is practical; that it could seriously interfere with no person's rights; that the assent of all parties interested might be obtained; that it would require a small expenditure of money, and if found not to work well, it could easily be removed. Why should not the experiment be tried?

I suppose that the harbor commissioners might authorize the driving of a few piles upon which this walk might rest, upon such terms as they considered safe and reasonable. Perhaps the means could be raised by private subscription, and the whole accomplished very soon, to a limited extent at least. Certainly such an experiment would be of more practical utility than the fine plans, now so numerous, of great parks which it will require years to complete, even after their location has been determined on. Let us hope that these may all be carried out in due time, as the wealth and population of the city increase. By the side of such ambitious projects, however, the one I now submit may seem insignificant. It certainly cannot be ushered in with a grand air. There is no opportunity for engineering, or fine plans with houses and gardens and driveways. If any are disposed to carry it out, they cannot hope for much glory, but must, like the honest Vicar of Wakefield, be contented with the satisfaction of having benefited society in a very ordinary and humdrum way. "I was ever of opinion," he says,

“ that the honest man who married and brought up a large family did more service than he who continued single and only talked of population.”

REPORT CONCERNING NAUSETT BEACH AND THE PENINSULA OF MONOMOY.

In the autumn of 1871, during a violent easterly gale, a breach was made by the sea through Nausett Beach nearly opposite the Chatham South Light, and the sea driving through attacked the water-front of the town. A short time after this event, I received notice to join you in a visit to the neighborhood, accompanied by Rear-Admiral Chas. H. Davis, and Prof. H. L. Whiting; and after reaching Chatham we held a consultation with a view to making a little investigation into the tendencies of these changes along this portion of the coast. The result of our conference was that you ordered me to make surveys from time to time and report. With this order I have complied, as well as I could with so many other duties, and this is my first report—in which I shall deal with facts only, leaving all discussion of causes till we learn more about them.

Physical History of the Neighborhood of Chatham.

The history of this portion of our coast really begins with Capt. Champlain's narratives (1606). It is true that we find some confused references to it in Archer's account of Gosnold's voyage, made some three or four years earlier, but there is in this account nothing *ship-shape*, and I am convinced that Archer formed no conception of the lay of the land. It is possible that the Gosnold expedition may have approached and left “Elizabeth Isle” by different routes—in one case passing through the Sounds, in the other going round the seaward islands and shoals, and that the narrator confounds the objects seen in these two voyages. For instance, on the 21st of May they seem to have entered Nantucket Sound from the *eastward*, and speak of the main land as trending south-westward; on the same day they fell in with No-man's Land, which they call Martha's Vineyard—a “*disinhabited*” island, where they saw “fast running thirteen savages apparelled as aforesaid,” and after lying three days in a place that I know, from experience, to be a very rough and dangerously exposed anchorage, they entered the Vineyard Sound from the *westward*!

The parties of Champlain made two visits to Cape Cod, in the first of which they ran across from Port St. Louis (Plymouth), and

in the second, from “Cap St. Louis,” described as lying two leagues from the aforesaid port.

In both trips they doubled the Cape and ran down the outer coast, but in the first only as far as *Malle Barre* (Nausett Inlet), where they found a *bad bar* at the entrance—just as at the present day.

From the narrative of the second trip I translate the following passages:—*

* * * “The last of September we left *Beauport*, passed *Cap St. Louis*, and ran all night for *Cap Blanc*. In the morning, an hour before day, we found ourselves to leeward of *Cap Blanc* in the *Bay blanche*, in eight feet of water, one league from the shore, where we came to anchor, in order not to get too near while waiting for daylight, and to see how the tides were. Nevertheless we sent out our boat to sound, and found no more than eight feet of water, so that it was necessary to consider before daylight what we ought to do. The water diminished even to five feet, and the heel of the vessel touched the sands, albeit without doing herself injury; for the sea was smooth and not less than three feet deep beneath us when the tide began to rise, which gave us good hope.

“At daybreak we perceived a very low, sandy shore, towards which we dragged further down to leeward, whence we sent a boat to sound towards a pretty high knoll where they judged there would be plenty of water; and in fact they found there seven fathoms. We anchored there, and at once equipped the boat with nine or ten men to go on shore to see a place where they judged they should have a good shelter if the wind should blow up stronger than it was. The search being successful, we carried in two, three and four fathoms of water and found five or six fathoms after we got in. There were plenty of oysters, which were very good, which we had not observed before, and we named the place Oyster Harbor, and it is in 42° of latitude. There came to us three canoes of savages. The wind came out fair in the course of the day, which induced us to quit our anchorage, and go to *Cap Blanc*, distant from this place five leagues to the north a quarter north-east, and we doubled it.

“The next day, 2d October, we were off *Malle Barre*, where we were detained sometime by headwinds, during which Mr. Poitricourt, with the boat and 12 to 15 men visited the harbor, where there came before them some 150 savages, singing and dancing in the usual way. After having seen this place, we returned to our vessel, and the wind coming fair we sailed along-shore running southward.”

Having come to the close of the author's chapter, I will pause in my quotation to discuss a little the narrative thus far.

Beauport, from which they started, was Gloucester, of which a pretty good chart is given, with the depth the same as now. *Cap St. Louis* was possibly Cohasset, but more likely Gurnet Point.

* From “Oeuvres de Champlain publiées sous le patronage de L'Université Laval, par L'Abbé C.-H. Laverdière, M.A., Professeur D'Histoire, &c.”

which is a promontory *apparently* projecting far beyond the adjacent land, which is low. This point was the *Krossanes* of the Northmen and the "*Poynt George*" of Capt. John Smith. They ran through the night for Cape Cod, which had received the name of *Cap Blanc* in the previous voyage, "by reason of its white dunes," which are very remarkable in the Province lands. They did not fetch so far to windward as they expected, and so got down on the Billingsgate Shoal where they found eight feet of water at low-tide, just as now. After daylight they worked their way to the northward into seven fathoms water, off Great Island, perhaps, whence they sent a sounding party into Wellfleet, the entrance to which is just about five leagues from the extremity of the Cape, although in lower latitude (some 10') than given in the narrative. The depths mentioned are much the same as our present charts give.

In the previous voyage they had got down into the bight of the bay much in the same way, but then it was because (as they state) they thought the forearm of Cape Cod was an island. It has that appearance, and I think the Northmen, six hundred years before, made precisely the same mistake, and that the "island lying north of the main land" seen by Leif was the same. Thorfinn Karlsefne, coming afterwards from the north fell to the southward of the end of the Cape outside, but believing it to be an island he attempted to go round the south end. These Northmen called the Cape *Kialarnes* after the land-mark (the old keel of a ship) set up by Thorwald Ericson. Capt. John Smith named the same point Cape James—some years after Gosnold had given it the name it now bears. Cape Cod.

The editor of this Quebec edition of Champlain makes the port reached on the 1st of October, Barnstable, perhaps because it better suits the present bearing of Cape Cod, and he adds that, "it seems to have bequeathed its ancient name to a portion of the present port, which is called Oyster Bay." Barnstable is in $41^{\circ} 43'$ and distant from the extremity of the Cape about twenty-one nautical miles. Our Coast-Survey chart of Barnstable mentions no Oyster Bay, but I need not go far off in any direction to find the word oyster applied in various ways.

Malle Barre was sketched on the previous voyage, so that we may be pretty sure that it was the present Nausett. The opening among the hills seems to promise, as seen from sea, a good port; but on near approach the mouth of the bay is nearly closed by a sand-beach, through which there have never been safe inlets. It was into this place I think that Thorfinn Karlsefne ventured in the hope of getting through to Vinland.

He seems to have subsequently gone up Nantucket Sound, and,

as he states, found himself to the southward of Vinland; which (as I make it) lay on the west shore of Cape Cod Bay where the "high tides" were found. (See *Antiquitates Americanæ*.)

As far as I know, this name *Malle Barre* is the only one from Champlain that has survived in Massachusetts; and even this showed at one time a disposition to slip off. As early as 1640 it had left Nausett and appeared in the *Atlas Novus* (a book of Dutch maps accompanied by Latin text), at the elbow of the Cape in co-partnership with *Vlackehoeck*.* The old name has gone out of popular use, but the words "Cape Malabar" still appear on our latest Coast-Survey chart attached to Monomoy Island.

"Continuation of aforesaid discoveries, and what they noticed remarkable. Chap. xix.

"As we got some six leagues from *Malle Barre*, we let go the anchor near the coast because we had no wind. Along these parts we descried the smoke which the savages made, which made us think of going to see them; so, to this end, we equipped the boat. But when we came near the shore, which is arenacious, we could not land because the breakers were too high. The savages, seeing this, launched a canoe and came to us, eight or nine of them, singing and making signs of joy that they felt at seeing us; and showed us that lower down there was a port where we could find safety for our vessel.

"Not being able to land, the boat returned to the vessel, and the savages, who had been treated humanely returned on shore.

"The next day, the wind being favorable, we continued our route to the north (?) five leagues, and had no sooner made this distance than we found three and four fathoms of water, being a league and a half from the shore. Going on a little further, the bottom rose suddenly to a fathom and a half and two fathoms, which frightened us, seeing that the sea broke everywhere without our seeing any passage by which we could return upon our road, because the wind was contrary. We were involved in such fashion, among the breakers and sand-banks, that it was necessary to pass at all hazards, according as one might judge of where lay the best water for our vessel, which was only four feet at most, and we came among the breakers up to four and a half feet.

"Finally we succeeded by the grace of God, in passing over a point of sand which juts out three leagues to the S. S. E.—a very dangerous place.

"Doubling this cape, that we named *Cap Batturier*, which is twelve to thirteen leagues from *Malle Barre*, we came to anchor in two and one-half fathoms, inasmuch as we saw around us everywhere breakers and shoals, except in some places where the sea was not breaking very much. We sent a boat to find a channel, in order to go to the place that we

* Upon this map Nantucket is called *Vlieland* and is joined to Martha's Vinyard, which is called *Texel*. Nantucket Sound is called *Luyder Zee*. The name "*Natocke*" appeared upon Dutch maps (for Nantucket) in 1671, and until that time *Port Fortune* survived as the name of Chatham Harbor.

judged to be the place that the savages had told us about, and believed that there was a river where we could be in safety.

"Our boat arriving there, our men went ashore and considered the place, and then returned with a savage that they brought off, who told us that at high-water we could get in, which we resolved to do, and immediately got up anchor and were conducted by the savage, who piloted us to cast anchor in a roadstead in front of the port having six fathoms of water, and good bottom, for we could not get inside because overtaken by the night.

"The next day we sent and put marks on the end of a bank of sand which is at the embouchure of the port, and then high-tide coming on we ran in with two fathoms of water. Having got there we praised God that we were in a place of safety. Our rudder had been broken and tied up with cords, and we feared that among the shallows and strong tides it would be broken again, which would have caused our loss.

"Within this port there is only one fathom at low-water, and two fathoms at high water; to the eastward there is a bay which runs up to the northward some three leagues in which there is an island and two other little bays, which diversify the country, where there is a good deal of cleared land and many small hills, where they cultivate corn and other grains, upon which they live. They have also fine grapes, quantities of hickory, oaks, cypress and a few pines. All the people in this place are very fond of agriculture, and make provision of Indian corn for the winter. * * * * *

"This would be a very proper place to found a republic, if the port was a little deeper and the entrance more sure than it is.

* * * * * "Nevertheless, we sent a boat with five or six men and a savage to see if they could find a better passage to go out than that by which we had come. Having made five or six leagues, and landed, the savage ran away. * * * When they returned they reported to us that as far as they had been there was at least three fathoms of water, and that beyond there were neither banks nor shallows. * * * The sixteenth of the month we left *Port Fortuné*, which we had so named for the unhappy circumstances which had befallen us there. It is in latitude $41\frac{1}{3}^{\circ}$, and some twelve or thirteen leagues from *Malle Barre*."

From the first clause of the foregoing chapter, it would appear that after passing Nausett they made another landing on the open coast *before getting beyond the limits of cultivated lands*. The distance given is evidently an overestimate, since so long a run directly south would have taken them to Monomoy Island, which is only a strip of beach sand. Moreover, when we consider that in the early part of the day, while "detained sometime by head winds," they had assisted at a dance on shore, and in the latter part of the day had come to anchor in a calm, and gone in their boat to meet the savages again, there would not seem to be much time left in the light of an autumn day, to make all these leagues. So I conclude that night found them at anchor above Chatham, and that the next

day's run was to the *southward* over the Pollock Rips, Shovelfull and other shoals of Monomoy and *northward*, up the west shore of Monomoy into the roadstead of Old Stage Harbor. The distance is again overestimated, but not more so than I have often been prone to myself when running along a beach which offered to the eye no objects by which to mark our progress. The sudden coming upon shoals wide out from a shore, that everywhere above had proved quite bold and free, is narrated quite graphically, and any sailor who has been so unfortunate as to get among the Monomoy Shoals will appreciate the hazard of attempting to double the point within the banks. Of course the shoals and beaches have shifted very much and often, since this strange little vessel of four feet draught braved their dangers; but we know from our studies of such shoals that the relative order of banks and beaches remains about the same, however the system as a whole may change its location.

The estimated length of the point of sand which he calls "*Cap Batturier*" (Cape Shallow), which is, of course, our Monomoy, proves quite correct,—but I shall hereafter show that this is proving a little too much, because this feature in the physical geography of our coast has been rather steadily growing since we have known it intimately by the light of good surveys.

The editor of the narrative under review, interprets *Cap Batturier* to mean Sankaty Head, Nantucket,—in order, I suppose, to accommodate the distance stated. Sankaty Head is no more entitled to be called a "*point of sand*" than Bunker Hill, which is geologically of the same formation; and how a vessel coming from the north can double Sankaty Head and reach Chatham Roadstead the same day, via Muskegat Channel or Vineyard Sound, I cannot see.

Chatham Roadstead, called on our Coast-Survey maps "Old Stage Harbor," is a good place in northerly and easterly gales, but with very strong south-westerly winds it is not safe even for able and well found vessels.

The ancient and recent charts of Chatham, which we have given side by side in the sketch that accompanies this paper, resemble each other sufficiently to leave no doubt of identity; but still by reason of very recent changes in the sand beach (the *Lido* in front of the promontory of Chatham) the likeness is not now so striking as it would have been if we had compared the ancient map with one of our previous surveys.

It will be observed that the ancient map is not properly oriented,—its compass is, in fact, swung out to the eastward some 20° from the true meridian. I am surprised at this, because, on the previous voyage, the variation of the compass had been determined at *Malle Barre* and found to be $18^{\circ} 40'$ west. Subsequent observations have shown

that the declination declined through the whole of the eighteenth century, falling as low as $6^{\circ} 38'$ W., at Cambridge University, while the present century shows a steady increase, so that now the declination of Cape Cod is about 11° west. Champlain has a good deal to say about the variation of the compass, and explains with a diagram his manner of laying out a meridian line.

The latitude given in the narrative for *Port Fortuné*, "forty-one and one-third degrees" is too low by about twenty minutes, while that given for *Beauport*, "forty-three," is about as much too high. The distances, measured by its own scale of *toises*, upon the map of *Port Fortuné*, are very wild,—the map has a twist, showing that it is in great measure perspective, corrected by estimated distances.

Notwithstanding all these defects there is something very *real* about the picture as it appears in its original form, with its hills and fields,—more real, in fact, than our modern map.* I have often thought when looking at Chinese, Japanese and old Dutch maps in which appear the likeness of hills and trees upon the land, and fishes in the sea, that I should much more easily recognize the scenes, if I were to visit them, after seeing such representations, than by the use of our modern topographical maps; and I believe that if the officers of Champlain, while at *Port Fortuné* had, in prophetic vision, seen our Coast-Survey plane-table sheet of Chatham, with all its conventional, if not arbitrary, signs they never would have dreamed what it meant. But our maps are not designed to furnish simply the means of recognition, or even a guide to navigation only; they are required to supply some of the wants of civil and military engineers, of geologists, agriculturists, &c., &c. To meet these wants, with the requisite economy of space, a technical language has been resorted to, which is not so artificial as the signs of mathematics, and scarcely less universal.

I must take occasion here to state that I am indebted to Mr. Francis Parkman, the historian, for the use of maps, &c., for looking up the physical history thus far.

There is a popular legend concerning a lost island which lay wide out to sea, off Chatham, which deserves consideration. As far as I can learn, the story first appeared in print in the "Massachusetts Magazine," and bears the date of December 1, 1790. It runs thus:—

"When the English first settled upon the Cape there was an island off Chatham, three leagues distant, called Webb's Island, containing twenty acres, covered with red cedar or savin. The inhabitants of Nantucket used to carry wood from it. This island has been wholly washed away

* I have left off these interior features from my sketch herewith.

for almost a century. A large rock that was upon the island, and which settled as the earth washed away, now marks the place; it rises as much above the bottom of the sea as it used to rise above the surface of the ground. The water is six fathoms deep on this spot."

Mr. Chapin, to whose report I shall refer more particularly hereafter, mentions that stumps bearing the marks of the axe still come on shore at Chatham.

The English Coast Pilot, 1707, has a map of Nantucket sound and shoals, which contains the name of "Webb's Island," extending from the flats below Chatham. No island is represented, or any shoal ground except the flats aforesaid. No mention is made of it in the sailing directions. There are three other islands off the point of Monomoy, called "Seale Isles" on this chart, which do not exist, but whose sites are dangerous shoals to-day.

Let us agree that a "Webb's Island" did exist; it remains to inquire whether it was a projecting part of the Cape or really a separate land. The tradition says there was a rock on it, so we may conclude that it was upland (drift formation), and not a broken piece of beach. If the distance, "three leagues," is correct, it was separate, because at this distance from the land (whether we take Chatham of 1606 or 1872), there are thirty-five to forty fathoms of water. If this distance was wrong (as such measures on the sea usually are in such traditions) but the depth—six fathoms—correct, we may plot the island within three thousand feet of points in Chatham which have remained permanent since the discovery of the continent. The six-fathom line hugs the shore now, within two thousand feet at many points.

Champlain's map of "*Nouvelle franse*" does not give this island, although his officers made two trips down the coast of Cape Cod, and on the second, passed this place a league and a-half off shore. These officers speak of Monomoy and other shoals, but do not mention an object which, if it had existed, would have been represented by them as a terror!

Again: it is said that the Nantucket people took wood from this island. Is it at all likely that they would have gone out past the "*Hankerchief*," "*Shovelfull*," "*Stone Horse*" and the "*Pollock Rips*," to an unsheltered island in the ocean, thirty-five miles from home, when they could have got all they wanted from Cotuit, Hyanis and other points from which they have brought wood within my knowledge?

There was, in the early part of the eighteenth century, as also in a large part of this, a passage-way—inside of the beach—from Nantucket Sound all the way up to Pleasant Bay above Chatham;

and some island accessible from this inside passage may have been visited for wood. Nantucket was settled in 1660, and the town of Sherburne incorporated 1687, at which time accounts state that the place was wooded, so we may presume that they were not driven to importing fuel till one generation at least had passed; before which time the strange island had gone down—nor do we find the stone that marks its grave.*

Of course I do not deny that great encroachments are being made by the sea wherever the *uplands* are exposed to the attacks of the waves. I say *uplands*, because wherever a skirting of alluvial beach is found, the work of destruction becomes intermittent, or ceases. And by *upland* I mean the *glacial drift* (so called) which, if we may judge from the underlying beds of shells in some cases, is itself an intruder upon the original domain of the sea.†

The very locality now under special examination affords a striking case of very recent encroachment by the sea. Upon our two little maps of Chatham, you will observe that the letter G in one case stands for an "*Isle remplis de bois*," and in the other for the *site* of Ram Island (washed away). It is difficult to determine how much of an island this was in 1606, because the Champlain map will not bear nice application of its own scale, but it may have been a hundred acres. It was at that time protected from the sea by the beach. Upon our first topographical sheet, that of Mr. Glück, in 1847, this island is still found, with an area of thirteen acres, an elevation of twenty feet at several points, and a house or building of some kind upon it. Its situation, relative to the ocean, had changed; a broad inlet had opened directly before it, and exposed it to the fury of the storm-waves. Mr. Marindin, from recent inquiry at Chatham, learned that this island had been used as a pasture down to 1851, when the memorable Minot's gale essentially closed its history. Traces of it remained for several years, but Messrs. Adams and Marindin, who made a topographical survey thereabout in 1868, saw nothing of it.

But the neighborhood of Chatham has not been generally one of great change since the time of Champlain, except in the continual shiftings of the *littoral cordon* of sand which skirts the shore. Judg-

* "The Nantucket Mirror & Enquirer" of Dec. 21, of this year, publishes an interesting article, showing from town records that orders were passed for the protection of timber and woods belonging to the town as early as 1663. The writer states that long previous to the Revolution wood was brought from the main land.

† The above had been written before I knew of Mr. Otis's "Account of the discovery of an ancient ship on the eastern shore of Cape Cod," which I have read with great interest and some dissent.

As the locality of the wreck is above the reach of our present surveys, I propose to reserve all comment on this matter till I can sound along the shore very carefully next season.

ing from the past history, I can but think that the oft-repeated statement that "*Cape Cod is fast washing away*" is an exaggeration.

Upon each of our little diagrams of Chatham you will observe a pond marked "E." It is a fresh pond in a hollow of the upland and is no nearer the sea-water now than it was 266 years ago, although the ocean has swept away, and re-formed, the beach in front repeatedly.

This strip of beach is familiar as a physical feature and falls under the general designation of the *littoral cordon*, a name which was applied to it by M. Elie de Beaumont in his *Geologie Pratique*. Upon the New England Coast it appears only here and there in a sporadic way, but below Montauk Point, Long Island, it is the characteristic feature all the way to Yucatan. I have discussed this formation somewhat at length in my article on the "Reclamation of Tide-lands," and shown in what manner it appears as the residual deposit after the sifting of the material torn from the coast by the waves.

Although it is prone to shift its position and change its form, its presence, on the whole, betokens a check in the conquest of land by the sea. In the instance before us there would seem to have been a general falling back of the cordon since 1606, but if we compare the two charts by using the distance from the pond "E," to the south end of Morris Island as a base, the change is not large; and I see no *positive* indication that the *cordon* is now undergoing final destruction, although I cannot find that at any previous period its area has been so small as now.

The map of 1606 shows a passage-way between Morris Island and the main land, and I find that the closure of this strait occurred between 1752 and 1772.* This *island* is upland (drift) and is connected now by a *sandy cordon* with the adjacent uplands of the main. This sandy cordon has blown up into dunes and a salt marsh has formed in the rear of it, over a channel which used to be navigable. Mr. Marindin learned while recently in Chatham, that traditions of this strait were quite familiar among the people, and that the last vessel that attempted the passage was a pink-stern schooner. The closure resulted from the falling back of the beach, and upon Des Barres' map of 1764, Monomoy appears as a peninsula extending southward from Morris Island and the main land.

Monomoy is a projection of the *littoral cordon* and has evidently been built of material torn from the Cape shore and its seaward aproning, under the attacks of a north-east sea, and is therefore very modern in a geological sense; but not recent from a historical point

* Massachusetts Historical Collections.

of view, as my accomplished young friend, H. A. Chapin, has presumed it to be in a recent communication.* It appears as a triangular shoal or dry flat upon Champlain's maps and was referred to in the narrative quoted above quite distinctly. A century later it appears upon the chart of the English Coast Pilot, as a long and broad island, and in the sailing directions it is said to lie "from the Tail of the Horseshoe about nine leagues E. N. E." Its point now lies north-east by east half east (true), eleven and three-quarters miles from the same place. As no part of Monomoy could be seen from the Horseshoe, and as the distance was a matter of longitude, it is not remarkable that the estimate should be very wild. If we suppose the sailing course correct by compass (of which the variation is stated to be 10°), Monomoy was about a mile and a quarter shorter in 1707 than it appears upon our first survey by Mr. Gilbert (1853).

In the "Description of Barnstable" (1802), published in the Massachusetts Historical Collections, the location of a humane house is carefully stated to be "four miles from the end of Monomoy Point and six miles from Chatham Great Hill which bore north by west." Plotting this upon our chart, with bearing corrected for variation, it appears that the house was situated close to the present outside shore-line near Wreck Cove, Monomoy Island, and that the point of the beach lacked but a quarter of a mile of being as far out in 1802 as in 1853 (the date of our first Coast-Survey topographical sheet). In this paper of 1802, it is stated that "the beach has been continually gaining during the past fifty years."

Of course there are plenty of maps extant which give different testimony, some of them published this very year, but all evidence is ruled out which is not from sources the mariner would respect, because to him and his protectors only had this worthless strip of beach the slightest significance. It was to him a terror, and chart-makers as well as humane societies made themselves familiar with its location.

Since 1853 Monomoy has been advancing with great rapidity into Nantucket Sound, the point moving out at the rate of 138 feet per annum between 1853 and 1856, and 157 feet per annum between 1856 and 1868.

Like Sandy Hook, a similar formation at the mouth of New York Harbor, this peninsula of Monomoy seems to have made alternately long pauses and rapid strides in its progress seaward. If this movement should continue till it passes on to the Hankerchief

* Mr. Chapin, aid in Mr. Granger's hydrographic party, was sent at my request to collect information, from the residents in this part of the Cape, relative to the destruction of Powder-Hole Harbor.

Shoal, a grand harbor of incalculable value will be created in place of the little Powder Hole, which has recently ceased to be. A movement similar to this, no doubt, formed the harbor of Provincetown at the extremity of the Cape, and I refer you to Prof. H. L. Whiting's report of 1867, for very interesting remarks concerning it.

The first mention of a harbor in the peninsula of Monomoy, that I find, is in the "Description of Barnstable," before mentioned. It is called Stewart's Bend, and is said to afford safe shelter in three or four fathoms. The word "bend" indicates that it received its name before it was actually a harbor—while it was only a hook.

In my boyhood the Powder Hole was considered a very valuable harbor of refuge, but when I ran into it with the Coast-Survey Schooner Bowditch, in 1856, forty fishing vessels, which lay there at anchor, packed it nearly full. Three fathoms, at low-tide, could be carried into this snug little place when our chart of 1854 was issued, and now Mr. Chapin reports only two feet!

Recent Movements of Chatham Beach in Detail.

Since the consultation held at Chatham, in the autumn of 1872, Mr. Marindin has made one regular plane-table survey in January, and a compass-survey during the present month. I quote the following clauses from his report to me of December 10:—

"Up to the time of my first survey, in January, 1872, no considerable encroachment of the sea upon the mainland of Chatham had occurred; but since that time many changes have occurred, which I have noted in my last visit to this place on the 6th of December, 1872.

"The two inlets, one known as the North Inlet, into what was called Old Harbor, at the southern extremity of Pleasant Bay, and the inlet which was made November 15, 1871, during an easterly gale, nearly opposite Chatham Lights, still exist. The former does not appear to have changed, but the latter has altered materially. The south end of the beach (north end of opening of November 15, 1871), which in January last had been thrown nearly midway into the harbor, has gradually extended in a south-westerly direction, and curving to the westward has joined on the main land near Chatham Lights. The height of the beach, where last winter there could be found two fathoms of water, is now nearly three feet above high-water, with a width varying from 100 to 135 feet. The whole beach, going northward, as far as the inlet of 1851, is gradually weakening, and must finally be beaten in on the Chatham shore.

"The north end of the lower beach (now Monomoy Beach since it is connected with Monomoy Island) has retreated to the southward, making the breach wider, as the opposite beach (at the north side of the inlet) does not seem to have followed the same course, but has turned off towards the main to the westward; and during the latter part of October last, when this north end was nearly opposite Chatham Lights

the sea again broke through this part of the beach, cutting off the end into a small island, as shown in the sketch. This island is being worn off by the seas and tidal-currents, and continually thrown farther into the harbor, so that in a few weeks it may no longer exist.

"There seems to be no distinct channel through the inlet into the harbor, the whole distance across being a continuous line of breakers when visited on December 7, 1872.

"Since the formation of the inlet (November 15, 1871), the main shore near Chatham Lights has been exposed to the sea, and consequently much worn, so that fears are entertained by Mr. C. H. Smith, keeper of the lights,—from whom most of my information was obtained,—for the safety of the lighthouse. The line of the bluff on which the lights stand has retreated nearly 100 feet since the new opening of last year. At the present time, however, the new position of the south end of the north beach, resting as it does on the shore near the lighthouses, has strengthened the shore, so that filling in is going on at the foot of the bluffs.

"From information gathered among the old inhabitants of Chatham, we find that great changes have taken place in the shores of this part of the Cape. Two hundred years ago the neck of land now connecting Morris Island with the main did not exist except as a shoaling up of the passage, and since that time tradition says that the last vessel which tried the passage was of the class known as 'pinky,' and that she grounded and failed to pass through."

We have been very much struck with the diminution in the area of the beach shown by the topographical maps since 1847, but we do not know whether this change is wholly superficial or not. I hope next season to have the opportunity to run a few normal lines of soundings, for future comparisons. Mr. Marindin's comparisons of areas and distances give the following:—

No. 1.—*Table of Areas of Chatham Beach, between Latitude 41° 39' and 41° 42'.*

BETWEEN LATITUDE—	AREA OF BEACH IN THE YEAR—				
	1847.	1868.	Loss of Area, 1847 TO '68.	1872.	Loss of Area. 1868 TO '72.
	Acres.	Acres.	Acres.	Acres.	Acres.
41° 39' and 41° 40', .	186	147	39	113	34
41° 40' " 41° 41', .	174	71	103	35	36
41° 41' " 41° 42', .	146	49	97	39	10
			239		80

From inspection of the above table we find the loss of area of the beach between 40° 39' and 41° 42' from 1847 to 1872 to be

319 acres, or 63 per cent. of the area in 1847. From 1847 to 1868 the loss was 239 acres, or 47 per cent. of the area in 1847. From 1868 to 1872 the loss was 80 acres, or 30 per cent. of the area in 1868.

No. 2.—*Table of Distances of Eastern Shore of Chatham Beach, West from Meridian 69° 55'.*

ON LATITUDE—	DISTANCE WEST OF MERIDIAN IN THE YEAR—				
	1847.	1868.	Retreat, 1847 TO '68.	1872.	Retreat, 1868 TO '72.
	Feet.	Feet.	Feet.	Feet.	Feet.
41° 39' 00'', .	6,475	6,075	+400	6,150	—75
41° 39' 15'', .	5,525	5,650	—125	5,802	—152
41° 39' 30'', .	4,925	5,275	—350	5,595	—320
41° 39' 45'', .	4,550	5,005	—455	5,405	—400
41° 40' 00'', .	4,255	4,795	—540	5,095	—300
41° 40' 15'', .	3,975	4,570	—595	Inlet (1871)	—
41° 40' 30'', .	3,625	4,285	—660	4,635	—350
41° 40' 45'', .	2,870	3,627	—757	3,895	—268
41° 41' 00'', .	2,060	3,127	—1,067	3,127	+0
41° 41' 15'', .	1,820	3,085	—1,265	3,060	+25
41° 41' 30'', .	1,520	4,352	—2,835	5,155	—800
41° 41' 45'', .	1,360	North Inlet,	—	North Inlet,	—
41° 42' 00'', .	Inlet,	Inlet,	—	Inlet,	—

Note.—Width of Beach on Latitude 41° 41' in 1847 = 1,700 feet.

“ “ “ “ “ in 1868 = 590 “

“ “ “ “ “ in 1872 = 590 “

The testimony of the preceding tables must not be understood as extending beyond the districts stated; because a large part of the littoral cordon on this part of the Cape-Cod shore, has remained unchanged since 1847.

I have already referred to a report from Mr. Chapin, aid in Mr. Granger's Coast-Survey party, touching this portion of Cape Cod. He was sent, by my request, to inquire into the circumstances under which the Powder Hole had been lost. He takes one of the interpretations of Archer's narrative, and gives to Monomoy a brief existence. I have no confidence in the narrative, but the physical history of Monomoy is an open question. If during the past two or three centuries the rate of growth southward has been as rapid as it has been since our surveys, there could not have been much of it in existence at the time of Gosnold's voyage. In my discussion of the case, from old maps, I have concluded for myself that this peninsula is much older than our knowledge of the coast—perhaps not as dry land, however.

I do not regard the shore line of these beaches as an important contour, *from a physical point of view*, but would rather take submerged curves ; for instance, the outline of the base of such a shoal upon the floor of the ocean. In the instance of Sandy Hook, New York, or Brewster Spit, in Boston Harbor, the advance is like that of a great mole building out into the sea, and its progress is most correctly measured from observations near the bottom, where it is not modified by causes so irregular as those near the surface.

I think the hydrographic survey, now in progress, will throw light on the question which Mr. Chapin has raised. He presumes that the material which is adding to the point, is from the waste of Chatham beach, &c. In the case of Sandy Hook I was able, by depositing materials of different specific weights, at different depths along the coast, to determine precisely whence the building materials came (1857-8). I found the source of supply in the neighborhood of Long Branch, twelve miles below the point of the Hook, where the upland has no protecting cordon of sand. I shall ask Mr. Chapin to make similar experiments on the Monomoy shore.

Mr. Chapin learned that seventy-five years ago, before Monomoy extended as far as now, there were islands on the shoal beyond, and as we know from our charts, very shallow spots existed off the point before the recent advance. In the growth of the point an apparent acceleration would take place on falling in with these. There are still some outlying dry spots mentioned by Mr. Granger from his past summer's observations.

There is a portion of Mr. Chapin's report—concerning the recent changes among the shoals—which I should like to quote in full, because it is interesting ; but as he does not give his authorities, and some of the old charts contradict him, I shall refer the matter to him again for review. When Mr. Granger's hydrographic survey is completed, these notes of Mr. Chapin's will furnish again valuable hints for the proper direction in which to make comparisons, and I expect to be indebted to him for further observations by that time.

Very respectfully yours,

HENRY MITCHELL,

Chief of Physical Hydrography, U.S. Coast Survey.

TO PROF. BENJAMIN PEIRCE, *Supt. U. S. Coast Survey, Cambridge, Mass.*

REPORT OF PROFESSOR HENRY L. WHITING,
ON HAULOVER BEACH, NANTUCKET.

PROFESSOR BENJAMIN PEIRCE, *Superintendent U. S. Coast Survey.*

DEAR SIR:—In compliance with your instructions, I proceeded, before the close of the field season of last fall, to make an examination and resurvey of the Haulover Beach, at the east end, or head, of Nantucket Harbor, for the purpose of ascertaining what changes, if any, had occurred in this beach, and to see if these changes would throw any light upon the disputed and uncertain question as to whether it belonged to, or was a part of the original formation and material of the main island, or whether it belonged to the class of "*littoral cordon*," referred to by Professor Mitchell, and found at the front of Cotamy Bay, and separating the waters of Vineyard Haven from the lagoon beyond.

The only point intended, or expected, to be solved by the results of my resurvey, was that of the movement, or non-movement, of the Haulover Beach, as a mass. In other words, to see if it had maintained its ground, or if it had fallen back *en masse* with the general waste of the outer eastern shore of the island, like the beach across the front of Cotamy Bay, which, while maintaining or retaining its general width and physical characteristics, has retreated before the driving power of the ocean's waves a distance of four hundred and fifty feet within the same time given for comparison as that afforded by my former and late surveys of the Haulover Beach, at Nantucket, the first survey being made in 1846 and the last in 1872. No intermediate survey, however, has been made of the Haulover as was the case in watching and testing the changes at Cotamy.

* * * * *

I found great difficulty in reviving the geographical positions of my former survey of Nantucket, upon which to base my present determinations for comparison. The ground in question was upon the extreme margin of my survey and my map, and not controlled by any local points of triangulation. To add further embarrassments, two of three old houses, the chimneys of which had been used as signal-points in the former survey, I found wanting; one house had been torn down, and the other rebuilt, so that the accuracy of their positions was uncertain. By obtaining data from more distant stations, however, I was finally enabled to make a redetermination of this beach, together with sufficient extent of the shore-line of the island south from the beach itself to give fair scope for a comparison.

The result of my survey made last fall gives no sign of change or movement in Haulover Beach. The mass, as a whole, remains upon

the same foundation: even the lines and details of sand hills, were they have not been exposed to the actual sea-waves, remain unchanged.

A very decided waste, however, has taken place along the outer face of the beach. Favoring all doubt in the accuracy of my resurvey, and giving the result showing most change, I find the present high-water line to be an average of about thirty metres, or about one hundred feet inside the former line, making the general width of the beach about that much less than it was in 1846. A slight accumulation of sand has taken place along the inside shore at the southerly end of the beach, or at what may be called the south-east bight of the bay or harbor, and some waste or driving back of the high-water line of beach has occurred at the north-east bight. The main alignment of the inner or harbor shore, however, remains much as it was in 1846. This proof of stability or fixedness of position is in favor of the possible benefits hoped for by opening this beach, as it goes to establish the theory of a long-existing barrier between the outer ocean and the waters of the harbor.

Without attempting or touching upon any discussion of geological questions, I wish to take this occasion to call your attention to one point which may bear favorably on the consequences of opening this beach.

In my considerations of the wasted headlands of this part of our coast, Sankaty Head has always been an interesting study. I think there is reason to assume that the mainland of the island extended not less than one mile to the eastward, or south-eastward, from the present limit of the cliffs,—assuming that the Haulover Beach, Coatoe and Great Point do *not* belong to the original drift formation of the island, but are deposits of later date formed under the lee, as it were, of the island land. When this shore of the island began to waste, a spit to the northward was a natural resultant of the forces at work upon the drifting material set loose. As greater waste went on this spit must have increased, and in extending formed the common and natural points and coves of Coatoe and Great Point. The stretch outward to Great Point I believe to be the last resultant, and caused by some change of forces. But whatever may have occasioned the extent and peculiar form and direction of this beach deposit, I think it is all a part and an extension of the first spit which made out from the mainland of the island, and that what remains of the Haulover beach to-day is a part of the original spit, as old, and probably older, than any other portion of it. The point I wish to make is this, that even if this beach is nothing more than a part of the original spit-deposit it has so extended and assumed such shapes and such direction, and has inclosed such peculiar

water spaces,—converting what was open water into a long lagoon with a narrow outlet forced by the extending breakers a long distance from the locality of the first separating spit,—that if this spit is now opened the tidal relations on either side of it may be found so changed as to create a current which will prove able to keep such an inlet open and be of practical use and value to the harbor. At any rate the proposition to open this beach seems sufficiently reasonable to warrant a trial of the experiment which I earnestly hope will be made.

Very respectfully submitted.

HENRY L. WHITING,
U. S. Coast Survey.

REPORT OF PROF. HENRY L. WHITING.
ON VINEYARD HAVEN.

Professor BENJAMIN PEIRCE, *Sup't U. S. Coast Survey.*

DEAR SIR:—In compliance with your instructions, after completing my surveys of Edgartown Harbor, in 1871, I examined the shores of Vineyard Haven, and the outline of the Chops, and made a resurvey of those portions of them where I found changes had taken place since my former survey in 1845.

But little change has occurred along the inner shores of the harbor. The Lagoon Inlet has worked and widened to the northward, but its points are now confined by the bridge-structure lately built across it.

Along the outside or eastern shore of East Chop the bluff has wasted away considerably; the summit line is now about seventy-five feet back from its line of 1845. This bluff extends north and south for a distance of about four thousand five hundred feet, with an average height of about forty feet, so that a large amount of material—over thirteen million cubic feet—has been cast into the waters of the sound, to be borne by wave and current action to some other resting-place. Immediately within the East Chop, and along the southerly shore of the harbor, quite an increase and advancement of the beach into the harbor has taken place. This continues from the point of the chop at the ending of the bluff to the most westerly wharf—known as Norris's wharf—about the same distance as that of the extent of bluffs outside. The average distance which this shore has made out is about forty-five feet, representing over three hundred thousand square feet of increased area of beach. Whether this accumulation and deposit of sands is from the material

of the bluffs washed down so near at hand, or whether it has come from other sources of supply, I will not presume to say.

On the north side of the harbor, along the shores of the West Chop, considerable change has taken place. The beach at the inner point of the chop, opposite the pond south from the light-house, has been cut away; but this waste is not so much in gross amount as that on the East Chop. Opposite the light-house the waste is not so great, but along the northern point of the chop and opposite the point where the old light-house stood, the waste is again larger, and the edge of the bluff is now about where the old light-house stood. From the end of the bluff, and along the shore of the sound westwardly from it, some increase of beach has taken place.*

Concerning questions of improvement and protection for this most important and valuable harbor, the thorough and elaborate physical surveys by Prof. Mitchell, give a better base for study and discussion than the slight changes above the water-line—the result and range of my survey—can furnish. I have, however, given much thought to this general subject, and have been familiar with this part of the coast, and had constant proof, by ocular demonstration, of the use and value of this harbor in particular, through a period of almost thirty years. I am induced, therefore, to lay before you the facts and premises which have influenced my own mind in contemplating the subject of its protection and improvement.

In his most able and interesting report, Prof. Mitchell makes wise distinction in describing Vineyard Haven, and designating it as a roadstead and not a harbor. He says, "It is distinguished neither for its amplitude nor its security, but preëminently for its convenience." Too much cannot be said concerning this latter characteristic. No matter how perfect a harbor of refuge may be, *per se*, it is of no avail, unless it be in such locality and have such relation in distance and direction, to the pathways of commerce and the points and elements of danger, as to make it *available*. This will be readily recognized by imagining one of the many excellent but useless harbors along the unfrequented parts of the coast of Maine transferred to within a daylight's run from Cape Hatteras, for instance. In another unpublished report, Prof. Mitchell also says, in speaking in praise of another harbor, "The great merit of it lies in a happy conjunction of many favorable elements, among which we may distinguish as most important, the facility and safety of its approaches; the ample width and depth of its entrance, and above all, the shelter and tranquillity of its roadsteads." The harbor, or roadstead, of

* As my maps have been returned to Washington, and are now in the Coast-Survey office, I am unable, at this time, to give precise statements as to these items of detail.

Vineyard Haven fulfills all these requisite conditions save one,—protection from the north-east. In all other winds its shelter and tranquility are sufficient. Added to the merit that it does afford as a roadstead, its *situation* makes it of great value as a refuge. It is just where a harbor is *most needed*. This is sometimes strikingly illustrated. I have seen the harbor entirely empty at sundown, and in the morning found it literally a “forest of masts.” On one particular occasion I remember to have counted one hundred and sixty vessels on the lifting of a fog in the morning, all of which had run in and come to anchor during the preceding night.

I make these, perhaps superfluous, statements as a preface to the assumption, or assertion, that the harbor, or roadstead or anchorage of Vineyard Haven is the most useful and most used, and therefore the most worthy of all possible practical improvement that can be put upon it to make it a perfect refuge, of any that can be named upon our Atlantic coast. I do not except Provincetown in this connection, which, although a far better harbor naturally, is not in so needed a situation. In bad weather (say north-easters) vessels will not leave Boston if bound south and westward; and if bound north and eastward, once around the Cape they can run for Boston. But at Vineyard Haven our coasters have had a long run either from New York or beyond the Delaware, and here first meet the most dangerous cruising-ground of our Atlantic coast.

In discussing the question of practical improvement, I feel great reluctance and hesitation to express an opinion contrary to the judgment of Prof. Mitchell, who has made the study of so many harbors and has so much knowledge on these general subjects; and when he says, “The hope of providing shelter for this roadstead is small; the entrance must not be closed by jetties from the chops, and the building of an isolated breakwater outside is impracticable, because of the great depth of water and the strong tide,” I confess I feel discouraged.

I agree with him fully in regard to the impracticability of building jetties from the Chops. His remarks concerning the opening of the Lagoon as an inner harbor are suggestions of much value in utilizing this deep and naturally sheltered water, but besides the objections in regard to ice, which he alludes to, the Lagoon is surrounded by quite high hills, which shut out the winds or make them baffling, so that, with its long and narrow configuration, it would be difficult for vessels to get in and out under sail. In fact, I think its occupation would necessitate the use of tugs, and in case of storms one tug would be quite insufficient to serve a crowd of vessels, all anxious to get in. A number of tugs, therefore, would have to be

in readiness, although, perhaps, not often called in use. And the Lagoon, although adding a feature of shelter, I fear will be found without the facility of access necessary to make it popular or even practically useful.

The difficulties in the problem of improvement are intrinsic. The elements of facility and safety not only of its approaches, but of the immediate entrance *must be secured*. The geographical position and situation of this harbor must not be overlooked. Its proximity to cruising grounds of difficulty and danger, where fogs prevail in summer, and blinding snowstorms rage in winter, is peculiar. In times of such emergency, and for night entrance and anchorage, free and simple access is of vital moment. While the mooring system and the Lagoon basin are valuable accessories, they are not such advantages as in times of greatest exigency would be practically available.

The improvement, therefore, most needed and most to be desired is the very one, it seems to me, about which Prof. Mitchell expresses the most doubt,—*an isolated outside breakwater*. And I can but hope that a more extended examination of the ground for this especial purpose, and a further consideration of the subject may develop conditions of practicability that will be more satisfactory.

The most serious and uncertain question of impracticability in connection with this proposition, is that of the strong current. The location of an isolated outside breakwater should be carefully considered in this connection. Although I do not base the statement on absolute data (Prof. Mitchell's observations not being made with a view to such a purpose and not falling on the precise ground in question), I think that a suitable location for a breakwater can be found where the current will not exceed two miles per hour. This velocity, with good bottom, is not so great as to give apprehension of much danger to such a structure. The alignment of a breakwater should be in a direction conforming as nearly as possible to the main direction of the currents, particularly in the north-westerly part of it, where they are the strongest. In extending the breakwater south-easterly it will reach and occupy ground where the currents are of less velocity, and where they will probably have no injurious influence.

In this preliminary study which I have made, and which is based only on the data of our published chart of these waters, I find the following location for a breakwater:—

The north-westerly terminus to be about midway between the East and West chops, and distant from them about one mile. From this point the alignment of the breakwater should be south-easterly and

toward the Squash Meadow Shoal. The position and direction of this elongated shoal seems to indicate it as the southerly margin of the channel between the Sounds, so nearly equally divided by the Hedge Fence Shoal. In looking at the map, the Squash Meadow Shoal to the eastward, and the Middle Ground to the westward, seem to define the pathway of the sweeping tides around the Chops, and to make the limit of their scouring action on the south side of the channel as the L'Homme Dieu does on the north side. Although the Squash Meadow Shoal may be the remains of a former island, or even part of the original chop, it is now undoubtedly shaped by the current action. I would, therefore, locate a breakwater as near as possible in conformity with what seems to be a physical boundary of flowage. At any rate, it should not extend or protrude beyond this line, and if entirely within its range, so much the better. At about midway the breakwater should begin to curve gradually to the south, in order to inclose the exposure to the south-east. In this direction it should extend sufficiently far to reach the line of protection afforded by Cape Poge.

The depth of water alluded to by Prof. Mitchell, is of course, a serious objection and a source of difficulty and expense in the construction of a breakwater. But it must be borne in mind that a harbor, to be of value, must have a deep entrance and inclose ground of first-class anchorage; and we can hardly imagine such conditions without the surroundings of deep-water navigation. The particular depth in which the suggested breakwater should be located, ranges from about eight to about five fathoms, or at its north-westerly end about fifty feet, and at its south-easterly end about thirty feet at high-water. This depth, with the length of structure, about two miles, or say about 10,000 feet, required to give full protection to the wide opening of the present roadstead is, of course, a structure of great magnitude; but when compared with other great breakwaters its dimensions are not extreme.

The Cherbourg Breakwater is 12,300 feet long and in 65 feet of water. Marseilles (not finished), 26,240 feet long, in 52 feet of water. Dover (original design), 10,591 feet long, in 70 feet of water. The riprap breakwater at Holyhead, north pier, is 7,300 feet long, in 63 feet of water, and cost about \$1,000 per running foot. The structure corresponding most nearly to the one suggested is that of the isolated breakwater at Portland, England. It can be said on the side of economy in our case that both shores of the Vineyard Sound abound in material. Boulders of every size can be found in positions favorable for transportation by every practicable method.

A breakwater of the dimensions and in the locality suggested will

triple the capacity of the harbor, and the area gained will all be of first-class anchorage. In other words, if the harbor has now, as Professor Mitchell states, an anchorage area of 544 acres, it will contain within the breakwater an area of about 1,500 acres, converted from what Professor Mitchell correctly designates as only a roadstead to a secure harbor. Unlike the situation of most of the great breakwaters of Europe, this one will be within the general shelter of Nantucket Sound, where no ocean-swell heaves in, and where the action of a short-running sea needs only to be broken to make the anchorage inside the breakwater secure. I would also add, that as the direction of exposure and of violent storm-waves is only from the eastward no heavy sea can break upon the structure except in an oblique direction, which favors its resisting power in its own stability and in breaking up a running sea.

The northerly opening to the harbor, as proposed, will be about one mile in width between the point of the West Chop and the north-westerly end of the breakwater. Outside of the eighteen-foot line the width of opening will be about three quarters of a mile. The southern opening will be a longer entrance, with a width from shore to breakwater of about half a mile; outside the eighteen-foot line about one-third of a mile, or, say, 1,500 feet. These widths, with lights on either chop and at either end of the breakwater, will make the entrance safe and practicable in the darkest night. This distance from the island shore gives ample room for tidal circulation both in preventing the accumulation of ice or drift-deposit. This is a vital and indispensable condition essential to the successful accomplishment of the scheme of the improvement.

I leave the question with the suggestive remarks which I have made. I believe the project a practicable one, and quite within the range of reasonable expenditure, considering the benefits to be derived.

A local question of some interest to the port of Vineyard Haven has been referred to the Board of Harbor Commissioners by its citizens, concerning the closing of the present inlet to the Lagoon Pond and controlling the flowage by water-gates.

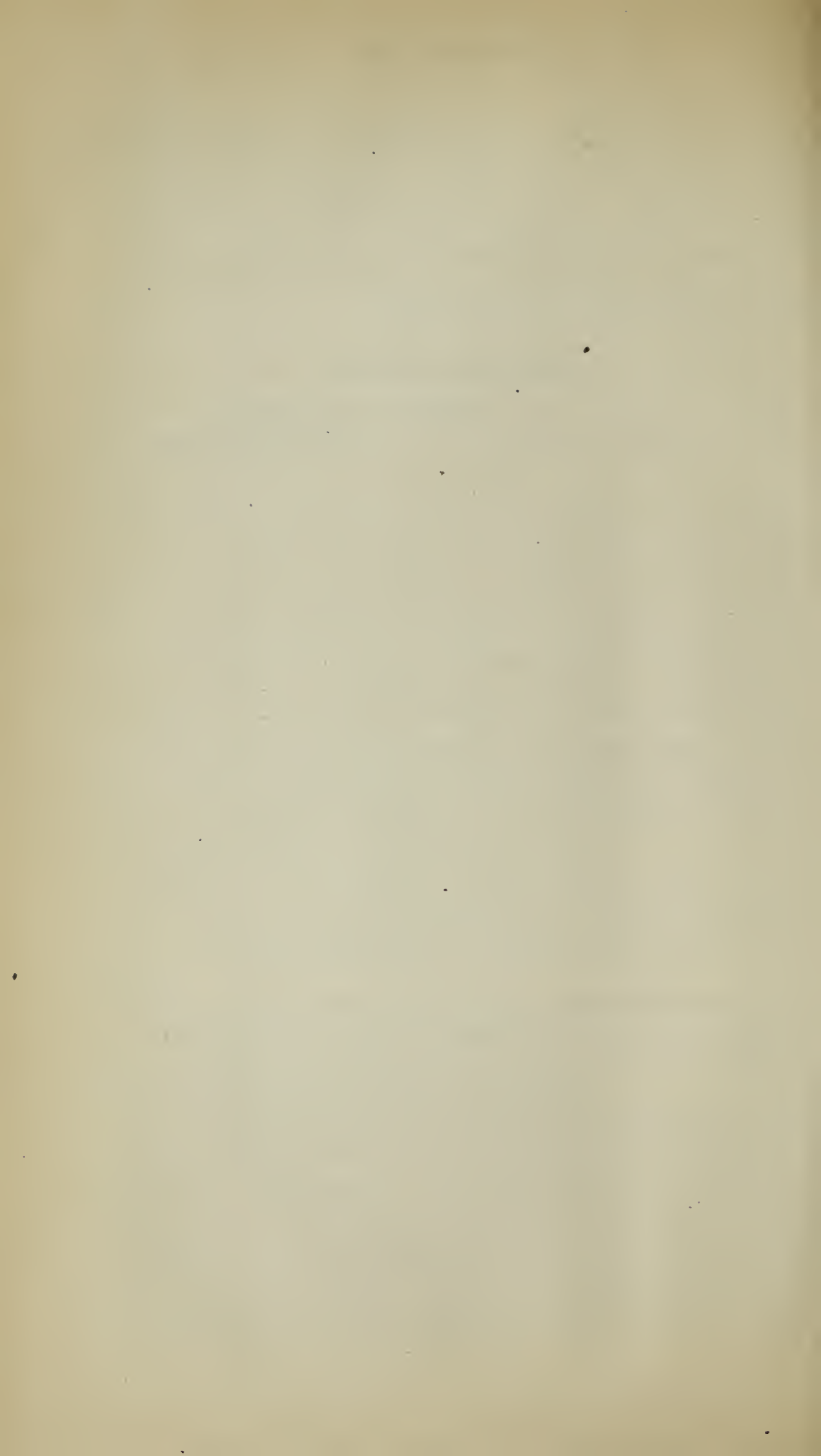
The shoal-water off this inlet on the harbor side, about one foot at low-water, makes the inlet as it is, of little value as an entrance to the shelter of the Lagoon. I deem the tidal-current through this inlet, so far as it has an influence in creating the bar in front of it, an injurious one. If closed and controlled by water-gates its value as a fishery would probably be far greater than any use that can be made of it in its natural state. In the event of making an opening to the Lagoon as an inner harbor of refuge the closing of the present inlet

would be of little moment. The operation of removing the artificial obstruction would be but a small addition to the work of general improvement, if made; and might not come within the range of such improvement. I see no objection, therefore, to closing the present inlet and substituting water-gates, but, on the contrary, should view it as an improvement of its natural condition.

I come to this judgment in no opposition to the suggestions of Professor Mitchell for opening the Lagoon.

Very respectfully submitted,

HENRY L. WHITING,
U. S. Coast Survey.



Commonwealth of Massachusetts.

In the Year One Thousand Eight Hundred and Seventy-Three.

AN ACT

To secure to the Commonwealth the Value of its
Property in Lands Flowed by Tide-Water.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:

1 SECT. 1. Whenever authority shall hereafter be
2 granted by the legislature or the board of harbor
3 commissioners, subject to the approval of the gov-
4 ernor and council, to any person or corporation to
5 build any wharf or other structure, or to fill or
6 otherwise occupy land in the tide-water lying
7 below the line of low-water mark, not exceeding
8 one hundred rods from high-water mark, the per-
9 son or corporation so authorized shall pay into the
10 treasury of the Commonwealth, before the work
11 authorized is begun, such compensation for the
12 rights and privileges granted as shall be deter-
13 mined by the governor and council to be just and
14 equitable, in addition to the compensation assessed
15 for tide-water displaced under chapter one hundred

16 and forty-nine of the acts of the year eighteen
17 hundred and sixty-six: *provided, however, that,*
18 when any price shall have been paid for such rights
19 and privileges, the same shall not be revocable
20 under chapter four hundred and thirty-two of the
21 acts of the year eighteen hundred and sixty-nine,
22 except upon a repayment of said price by the Com-
23 monwealth to the party entitled to the same.

1 SECT. 2. This act shall not apply to any rights
2 or privileges granted for municipal or county pur-
3 poses to any city, town or county in land of the
4 Commonwealth flowed by tide-water.

1 SECT. 3. This act shall take effect upon its
2 passage.

ERRATA.

On page fifty-two insert *not* before "moved," in the sixth line from the bottom. In the twenty-second line from the bottom, change "typographical" to "topographical."

EIGHTH ANNUAL REPORT

OF THE

BOARD OF HARBOR COMMISSIONERS.

JANUARY, 1874.

BOSTON:

WRIGHT & POTTER, STATE PRINTERS,
CORNER OF MILK AND FEDERAL STREETS.

1874.

R E P O R T .

*To the Honorable Senate and House of Representatives of the Commonwealth of
Massachusetts.*

The Board of Harbor Commissioners respectfully submit their Eighth Annual Report.

SOUTH BOSTON FLATS.

It gives the Board great satisfaction to be able to announce that the negotiation with the Boston Wharf Company, the Boston & Albany Railroad Company and the City of Boston of terms of coöperation in the improvement of the South Boston flats, incomplete when the Seventh Annual Report of this Board was submitted, has, during the past year, been fully consummated.

The results of that negotiation are embodied in two instruments, copies of which are appended to this Report, one being an indenture of four parts executed by the three parties named, and the Commonwealth acting by this Board; the other an agreement between the Commonwealth and the Boston & Albany Railroad Company. The indenture of four parts, in its main features, is on one side an agreement with the City of Boston, the Boston Wharf Company, the Boston & Albany Railroad Company and the Commonwealth, to inclose with sea-walls on the borders of Fort Point Channel, and the Main Channel of Boston Harbor, and fill on or before October 1st, 1876, their several parcels of flats on the southeasterly side of Fort Point Channel, comprising in all about one hundred acres, of which the Boston Wharf Company and the Commonwealth own two adjacent parcels containing each about twenty-five acres bordering on Fort Point Channel, and the Boston & Albany Railroad Company a third parcel of fifty acres adjacent, bought by it of the Commonwealth, and border-

ing on the Main Channel, and within the limits of their respective parcels to convey to the city when filled, Eastern Avenue, Northern Avenue, and the extension of Washington Avenue, B, C, D, E, F, K and L Streets, and obligates the Commonwealth in one year after the filling of these hundred acres, to extend B or C Street to Eastern Avenue. On the other side the city of Boston agrees with the Boston Wharf Company, the Boston & Albany Railroad Company and the Commonwealth, to connect this territory to be filled with the city proper by bridges over Fort Point Channel.

The city required that provision should be made in this indenture for streets over these hundred acres, and over the residue of the first section of the South Boston flats belonging to the Commonwealth as fast as its flats should be improved, and for the conveyance to the city of the title in fee simple to all these streets when filled.

By the Act of the year of 1869, chap. 461, sect. 4, the Boston & Albany Railroad Company was authorized to lay its tracks across and along portions of the streets which the city desired should be laid out over the flats the company had purchased of the Commonwealth, but the railroad company was unwilling to convey the fee in such streets without reserving those rights in them which the legislature had given it, some of which were regarded as indispensable to the occupation of its land for railroad purposes. On the other hand the city was unwilling to agree to build expensive bridges in extension of Eastern Avenue and Northern Avenue over Fort Point Channel, while the railroad company reserved to itself the legal right to obstruct the avenues terminating in these bridges so completely with its freight tracks as to make them unsuitable for public travel beyond the company's land. This conflict of interests remained to be adjusted at the beginning of the past year.

Another subject of great importance became involved in this negotiation upon its resumption by the Board.

The Boston & Albany Railroad Company had applied to the legislature of 1873 for a modification of its obligation to pay the purchase-money for the fifty acres of flats bought by it of the Commonwealth in 1869, amounting to \$445,635, and having become due October 1st, 1872. This application was

referred to the committee on expenditures. It appearing, however, to the committee, and it being the opinion of the attorney-general, that the Board of Harbor Commissioners, with the approval of the governor and council, had the same authority by law (chap. 326, Acts 1868) to modify the agreement with the company that they had originally to make it, the committee deemed it advisable to leave the matter with the Board and the governor and council, especially in view of the fact that for the purpose of enlisting the coöperation of the city of Boston in the general scheme for the improvement of the South Boston flats, the Commonwealth desired some concessions from the railroad company. Accordingly, the legislature adopted the recommendation of its committee, and took no action upon the company's application.

To appreciate the grounds on which this claim to an extension of the time of payment was made, it is necessary to state the circumstances under which the the Boston & Albany Railroad Company purchased these flats and agreed to fill them.

At the time that these fifty acres were sold to the Boston & Albany Railroad Company, the Commonwealth had sold to the Boston, Hartford & Erie Railroad Company the parcel containing about twenty-five acres lying adjacent to these fifty acres and bordering on Fort Point Channel, which, with twenty-five acres more bought of the Boston Wharf Company, the Boston, Hartford & Erie Railroad Company agreed with the Commonwealth to fill, in accordance with the Commonwealth's plan for this improvement. These two parcels of twenty-five acres each, lay adjacent to each other between the parcel of the Boston & Albany Railroad Company and Fort Point Channel. The Boston, Hartford & Erie Railroad was to have three years for filling its two parcels, amounting to fifty acres, and for the same time was to pay no interest on its purchase-money.

The Boston & Albany Railroad Company also, not having to pay its purchase-money for these three years, had in effect the same three years' exemption from interest, but had six years in which to do the whole of its work, although it had only the same area to fill and its work would require no longer time to complete.

It was allowed no greater exemption from interest, because it needed no longer time to improve its flats for profitable occupation. From these provisions the company claimed it was a fair inference that it was the intention of the parties to the agreement that before the company should be obliged to pay for its flats it should have three years during which it would be possible to improve them in the manner required by the contract.

In the plan of the Commonwealth for filling these hundred acres, it was always intended that the flats bordering on Fort Point Channel should be filled before those lower down the harbor; certainly, that the sea-wall on the borders of those flats on Fort Point Channel should first be built to serve as a protection of the area to be filled, from the action of the currents of the harbor channels.

A different order in the occupation of these flats would, in the judgment of this Board, have been injurious to the harbor. The extension out to the Main Channel of a solid mole within the limits of the flats of the Boston & Albany Railroad Company, such as the separate and independent improvement of its parcel would have made, would have acted as an abrupt obstruction to the ebb-current, and caused a powerful eddy of large circuit, whose action would have resulted in an extensive excavation of the flats of the Commonwealth now to be filled, and corresponding deposits, probably, in the main ship channel.

Practically speaking, therefore, the Boston & Albany Railroad Company could fill its flats only after the flats of the Boston, Hartford & Erie Railroad Company had been filled, or simultaneously with the progress of the work upon them. The understanding of all parties in 1869, that these two railroad companies were to improve their parcels upon one plan, and that the tract which was second in the order of occupation was not to be improved except in connection with the tract whose improvement must first be secured, was also appealed to.

It was claimed, moreover, that the clauses in the agreement of the Boston & Albany Railroad Company by which the company bound itself to fill on any portion of the westerly line of said parcel of flats simultaneously with the progress or

after the filling or other occupation there, on the easterly line of the westerly adjoining flats conveyed by said Commonwealth and the Boston Wharf Company to "the trustees of the Boston, Hartford & Erie Railroad Company, and furthermore agreed so to build its wall on the main channel as to unite said wall with the sea-wall built * * * on said adjoining westerly parcel of flats conveyed by the Commonwealth to said * * * trustees so that both walls shall form a continuous and uniform structure," showed that the intention of the agreement was, that the work on both parcels should be done together.

The bankruptcy of the Boston, Hartford & Erie Railroad Company, however, prevented the improvement of that portion of the flats that ought first to be improved, and not until the month of October, 1873, was this work undertaken under auspices that insured its completion.

Accordingly, as there has been no time prior to the past year since its purchase in 1869 when the Boston & Albany Railroad Company could do the work to be done on its flats simultaneously with or in continuation of the work on the adjacent flats that must first or simultaneously with its own be filled, it claimed that as a matter of justice, the three years it was to have in which to do its work should not be deemed to have begun before October, 1873, and that it should have three years from that date, viz., until October, 1876, to do its work and pay the purchase-money. The verity of the grounds of this claim could not be denied.

On the other hand, whatever may have been the expectations of the contracting parties, the obligation of the company to pay for its flats at the expiration of three years from October 1st, 1869, was not by the terms of the instrument made in any manner dependent upon the state or progress of the work on the adjoining territory between its own tract and Fort Point Channel. On its contract the company was legally liable to pay the purchase-money on the 1st of October, 1872. The claim for an extension of the time of payment to October 1st, 1876, was a claim, therefore, in effect for the remission of four years' interest at six per cent on \$445,600, amounting to \$106,944.

It became necessary, then, for the Board to determine

whether the interests of the Commonwealth required an enforcement of the obligation of the company according to the letter of the bond or a concession to its claim for an extension of the time of payment, for the sake of securing its execution of the proposed indenture of four parts, without which the indispensable coöperation of the city in the improvement of the South Boston flats could not be obtained.

This coöperation of the city was to give the flats of the Commonwealth in South Boston direct communication with the city proper by bridges over Fort Point Channel, which could not be affected at a less cost than \$700,000, an expenditure which the Commonwealth would never have incurred, and without which the flats of the Commonwealth when filled would be of much less value. If it were estimated that the twenty-five acres of the flats which the State proposed to fill itself would be enhanced ten cents a foot in value by the construction of these bridges, the benefit would exceed the whole amount of interest whose remission was sought.

But the execution of this indenture of four parts was to inaugurate a plan of improvement that enhanced, not twenty-five, but between seven and eight hundred acres of flats owned by the Commonwealth.

The Board could not doubt that its clear duty in the premises was to yield to a claim having so much of justice in it for the sake of obtaining the indispensable coöperation of the party making it in a cherished project of the State.

The Boston & Albany Railroad Company then consented to such concessions of its right to lay tracks across and along the streets over its territory as obviated all the objections of the city. It agreed to limit its rights in Eastern Avenue to a right to lay its tracks across it, and its rights in B Street between Eastern Avenue and Northern Avenue to a right to lay its tracks along it in such location as should be agreed upon by the company and the board of aldermen of the city of Boston. These concessions made it necessary for the company to relinquish so much of its territory as lies south-west of Eastern Avenue, as it would cease to be serviceable under these restrictions for the location and use of its tracks. It was agreed, however, that the company might take in place of the area relinquished, a strip along the south-westerly border

of the tract of the Commonwealth at the junction of the two channels, in the proportion of two feet here for every five feet relinquished. The area of whatever portion of the company's tract should be thrown south of Eastern Avenue by any change in its location, and in consequence surrendered, the company was to be allowed to take in a strip of equal width on the south-easterly border of its flats, or, at its option, have the value of the same, at the rate at which it was purchased, deducted from its purchase-money. The company was also released from its obligation to fill simultaneously with any filling by the co-terminous owner on its south-easterly line to the extent of the length of the dock, in case it should build one on this part of its territory, and wall in its north-westerly and south-westerly sides. Such filling as has been done on the territory to be relinquished by the company the Commonwealth was to have the benefit of without charge. As the Commonwealth would get the benefit of the sea-wall, between eight and nine hundred feet in length on the Main Channel, for the flats of the company to be relinquished, the cost of the sea-wall on the equivalent strip, estimated at less than a hundred feet in width, which the company was to have in exchange on the south-easterly margin of the Commonwealth's parcel was to be deducted from the purchase-money to be paid by the company.

Again, as Eastern Avenue by the surrender of all the company's land on the south-west side of it, was to become a street on the division-line between the lands of the company and those of the Commonwealth, it was agreed that one-half the cost of the filling of this avenue should be borne by the Commonwealth and one-half by the company, instead of wholly by the company, as was the case by the agreement of 1869, according to which the land of the company was to lie on both sides of the avenue.

By the indenture of four parts provision was made at the request of the city for making Northern Avenue one hundred instead of seventy-five feet wide, as provided in the agreement of 1869 between the Commonwealth and the company, Eastern Avenue seventy-five feet wide instead of sixty-six, and B Street on the territory of the company seventy-five feet wide instead of fifty, and it was agreed that the company should

not be required to pay for the additional amount of flats within its limits to be devoted to streets and conveyed to the city, while, on the other hand, the cost of filling these streets to the enlarged width was still to be borne by the company.

The mutual compromise between the company and the Commonwealth, whose principal terms have been stated, was embodied in the agreement already mentioned which was executed by the company and this Board, and approved by the governor and council,

After these two contracts, establishing a satisfactory basis upon which the improvement of the South Boston flats could be begun, had been executed by the parties and approved by the governor and council, this Board advertised for proposals for inclosing with the requisite sea-walls and filling the flats of the Commonwealth at the junction of the Main and Fort Point Channels. In the hope of possibly selling these flats at a fair price to some party or parties who could perform all the obligations of the Commonwealth incurred under the indenture of four parts, and so save the State the necessity of contracting for work usually better left to private enterprise, the Board at the same time it invited sealed proposals for the sea-walls and the filling, also invited sealed proposals for the purchase of this parcel of flats, the purchaser to improve them as the Commonwealth binds itself to improve them in this indenture.

The advertisement for proposals to be opened on the twentieth of August last was published in most of the Boston newspapers, in the "Portland Press," the "New York Herald" and the "New York Tribune" for six weeks.

The plans of the sea-walls for which proposals were first invited were those adopted in the year 1868, and ever since shown on the plan for the occupation of the Commonwealth's flats in South Boston, appended to the reports of the Board, with the exception of a few slight changes in the light sea-wall.

Upon the suggestion, however, of Edward S. Philbrick, Esq., whom the Board had selected to act as superintending engineer of the work on the Commonwealth's flats in South Boston, that in his judgment the plan of the heavy sea-wall might be improved, alterations proposed by him, and sanc-

tioned by the weighty authority of James B. Francis, Esq., of Lowell, as improvements upon the original plan, were adopted.

On the twentieth day of August, the day for opening the bids, the application of some contractors living out of the State for more time to prepare their bids, concurred with the desire of the Board for proposals upon the modified plan for the heavy sea-wall which had then been matured.

Accordingly the Board extended the time for submitting proposals until the third day of September, and advertised for bids on the modified plan as an alternative plan for the heavy sea-wall. On opening the bids it was found that the heavy sea-wall, built according to the modified plan, would cost twelve dollars less a running foot to build than if built according to the original plan.

To obtain the largest competition, the Board had advertised for separate proposals for the light sea-wall, for the heavy sea-wall, and for the filling of the flats to grade 16, with material dredged from the harbor up to grade 13, the remainder with gravel, and for doing the whole work, both filling and sea-walls. The lowest aggregate proposal was that of Messrs. Clapp & Ballou and the Rockport Granite Company of Massachusetts, who bid \$39 a running foot for the light sea-wall, \$236 a running foot for the heavy sea-wall, and 39 cents per square foot for the filling.

By combining the lowest separate bids which were given by three different parties, the aggregate of these was \$26,168 less than the aggregate bid of Messrs. Clapp & Ballou and the Rockport Granite Company, but it seemed to the Board that unity of responsibility in a contract of such magnitude, in relation to a work in which progress in one part might be dependent upon the progress of the work in another part, was worth more to the Commonwealth than would be saved by contracting with three parties instead of one.

The Board, therefore, awarded the contract for the whole work to Messrs. Clapp & Ballou and the Rockport Granite Company, and submitted its award, together with all the bids, to the governor and council for preliminary approval before making the contract, and to obtain their opinion, in case the

award was approved, as to the proper guaranty for the faithful performance of the contract.

The governor and council approved the award, and advised that the contractors should give this guaranty in the form of a bond, with responsible sureties, in the sum of two hundred and fifty thousand dollars. The contract was executed in pursuance of the award, and a bond, such as had been recommended, was given. The contract and bond, copies of which are appended to this Report, were approved by the governor and council, and on the 14th day of October, 1873, the improvement of the South Boston flats was begun under the auspices of the Commonwealth. The work has been in progress ever since. Under the contract the total cost of improving the Commonwealth's flats is \$793,691.60, a sum exceeding the estimates submitted by the Board to the legislature in 1871, when the price of stone was somewhat lower, by only \$74,379.73.

The location of Eastern Avenue, as fixed by the action of the Board, with the approval of the governor and council, and the concurrence of the committee on streets of the city council, is shown on the plan appended to this Report. Congress Street is to be extended to the Commissioners' line on the north-westerly side of Fort Point Channel, thence the avenue crosses the channel at right angles to the middle line between the Commissioners' lines on the two sides of the channel, and from the Commissioners' line on the southeasterly side of the channel runs parallel with Broadway as far as to the extension of E Street.

The line at right angles with the middle line of the channel was adopted in preference to an oblique line, for the reason that the bridge so built would cost less, cause less obstruction to the water, require shorter stringers for the draw, and enable it, when opened, to turn end for end. This capacity in a draw makes it possible, by continuing in the same direction the movement of the draw after it is opened, to begin the process of closing it before a passing vessel has got through, and thus lessen the time required for the passage of vessels.

Since Eastern Avenue was located the street commissioners have passed the order taking the land required for the connection of Eastern Avenue with Broad Street, and the plans

for the bridge are already engaging the attention of the city engineer.

The Board is much gratified at the adoption by the board of aldermen of the recommendation of this Board that the bridge should be of such a grade as will admit the passage under the draw of tug-boats with lowered smoke-stacks, and obviate the necessity of opening it merely to let a tug-boat through. There are tugs that require but twelve feet above high-water to give them unobstructed passage.

When the bridge of Eastern Avenue has been built at this grade above high-water, the city should have the power to prohibit the opening of the draw for the passage of tug-boats unaccompanied by a vessel in tow. The effect of this would simply be that tugs with pilot-houses twelve feet or under above the water-line would be the only ones that could be used at substantially all times of the tide. For short periods of time at the turns of the tide, a few days in a year, tug-boats requiring twelve feet space above high-water to clear the draw would be delayed under this restriction.

Such a regulation of the navigation of the channel for the sake of reducing the detentions of travel over the bridge, would certainly be a reasonable one.

APPROPRIATION FOR BOSTON HARBOR.

By the Report of the Committee on Commerce of the National House of Representatives, made last winter, only \$75,000 were given for the year 1873 to continue the necessary work for the preservation of Boston Harbor, although the Board had by its memorial to Congress set forth the especial need of a larger sum of money.

Notwithstanding discouraging representations of the impossibility of getting a larger appropriation, the Board felt that the urgency of the case required that an effort should be made to secure it. Accordingly, while the appropriation bill was pending before the Senate Committee on Commerce a committee of the Board, consisting of Messrs. Lincoln and Grammer, with Professor Whiting, went to Washington and presented the claims of Boston Harbor for more favorable consideration. The Board was fortunate in obtaining, in this appeal to Congress, the coöperation of his Honor, Mayor

Pierce, who joined the committee of the Board in Washington, and went before the committee of the Senate. Prof. Peirce, Superintendent of the U. S. Coast Survey, who was then in Washington, also appeared before the Senate committee and gave his weighty sanction to the justice of the claim made for Boston Harbor.

The hearing resulted in a prompt recommendation that the amount given by the House bill should be doubled, and the appropriation bill, as finally passed, gave Boston Harbor \$150,000.

This amount was the least that should have been entertained, considering the amount of work to be done in building sea-walls, to save islands and headlands from washing away and filling up with their substance the harbor channels, and in the dredging needed at the Upper Middle.

LONG ISLAND IN BOSTON HARBOR.

Last October the attention of the Board was called, by Hon. Thomas Russell, collector of the port of Boston, to the fact that in a recent storm, at a very high tide, the sea had passed over the neck of land connecting the South Head with the main portion of Long Island, and that Sculpin Channel was imperilled by this encroachment. Upon his invitation the Board visited the locality in the U. S. revenue steamer, and found these representations fully justified.

The Board reported the facts to Gen. George Thom, of the U. S. Engineers, who has charge of the government work in Boston Harbor, with a request that he would examine the subject and take such action for the protection of the shores and lands of the island as he might deem expedient and practicable.

In the succeeding month the following reply was received :—

UNITED STATES ENGINEERS' OFFICE, }
PORTLAND, ME., NOV. 7, 1873. }

HON. JOSIAH QUINCY, *Chairman Board of Harbor Commissioners,*
8 Pemberton Square, Boston, Mass :

DEAR SIR :—Since my letter to your Board of the 17th ultimo, I have, in compliance with the request contained in your communication of the 16th ultimo, caused a survey to be made of that part of Long Island which was washed over by the storm and high tides of

last month, and I have also myself made an examination of it. This survey, when compared with the survey of the same locality made in 1860, by Mr. Henry L. Whiting, shows,—

First, That both the eastern and western shore crests of the low neck of land which connects the South Head with the main part of Long Island, have been considerably weakened since 1860, in width as well as in height, but that the main body of the low land does not appear to have changed materially in character or level.

Second, That “Sculpin Channel” has been somewhat encroached upon, the 12-foot curve being now about 60 feet further from the shore. It also appears that all the damage thus far done has been caused by the removal for sale, of a very large quantity of stone ballast, gravel and sand from the shores, by the owner of the land, with the permission, as I am informed, of the municipal authorities. It was shown, at a recent meeting of the common council, that gravel to the amount of 10,000 or 12,000 tons was removed to T Wharf alone from June 1st till September.

Now, if this removal of material be permitted to continue, it will doubtless result in the opening, at no distant day, of a channel across the island to the great injury of Sculpin Channel, a state of things that even now will be likely to take place unless some action be soon taken for the protection and strengthening by a stone apron-work or otherwise of the shores thus weakened.

The question arises, by whom this work should be done, the owner of the land who has done the injury by the removal and sale of the material, or the municipal authorities which have granted him permission so to do. I do not think that the U. S. government should be called upon, under the circumstances, to restore the shores to their former condition.

The cost of a suitable apron-work of stone would probably be about \$20,000. At present there are no funds in my charge that are available for the purpose.

Very respectfully, your obedient servant,

GEO. THOM,

Lieut.-Col. of Engineers, Bvt. Brig.-Gen., U. S. A.

Subsequently, in the latter part of the month of November last, Gen. Thom informed the Board that something had been done by him for the protection of the channel, although it was but a small part of what should be done.

The Board communicated the letter of Gen. Thom to the city council of Boston, and it was referred to the harbor

committee of that body. It is hoped that the city will recognize the justice of the suggestion of Gen. Thom, that as the injury has resulted from municipal action, the city will bear the expense of the remedy. If it should appear that by receiving supplies of ballast material from Long Island, under its own licenses, the city has obtained the material at a lower cost than it could have been supplied from proper localities, the justice of Gen. Thom's claim that the expense of protecting the harbor from the consequences of its own action, would be made even clearer.

This appeal to the city to pay the damage done under its authority may suggest the expediency of its surrendering the power reserved to it, under laws of the Commonwealth, of authorizing the removal of ballast and other material from the islands and beaches of the harbor, or the propriety of transferring this power to the Board of Harbor Commissioners.

PRESERVATION OF BEACHES.

The law, as it stands, does not furnish the effective remedies that are desirable for the protection of such beaches as the public interest requires should be preserved.

Power is given the Board to prevent, by injunction, the removal of material from any bar or breakwater of a harbor. (Sec. 5, ch. 149, St. 1866.)

There are, however, many beaches which ought to be protected, that are not either bars or breakwaters to a harbor. Besides, the remedy by injunction is not a speedy enough process to arrest the work of a ballast lighter, that comes one day and gets a cargo of material from a beach and the next day sails off.

Where this material is taken without the consent of the owner and against his will, the law is sufficient for the case. But when the removal of the material is with his consent, although against the public interest, and thereby some natural barrier to a large inland territory is weakened, or the communication by land to some government work is impaired, there is no clear way of protecting the general interest. Perhaps there is no way of remedying the difficulty except that of passing a law for each beach which it is desirable to preserve.

The Board is frequently appealed to by municipal and national authorities to put a stop to the destruction of these natural barriers against the sea, and often finds it doubtful whether the law furnishes any remedy in the case. The subject is respectfully submitted to the consideration of the legislature.

SURVEY OF BOSTON HARBOR.

In view of the great changes that the South Boston improvement will in a few years make in Boston Harbor, it is very desirable that the existing state of the harbor be ascertained by a new survey of some portions of it as a means of tracing the effects of those changes.

It is especially important to the Commonwealth that no change in the harbor for the worse should be attributed to the South Boston improvement, for the reason that in the Act authorizing it the Commonwealth made the following pledge: "If it shall appear from hydrographical and physical surveys that injury to the harbor has resulted from the work herein authorized then such injury shall be repaired by dredging or otherwise in such manner and to such extent as the legislature shall hereafter determine."

To obtain such a survey by the United States Coast Survey at the beginning of this work, the Board addressed to Prof. Peirce, the superintendent of the United States Coast Survey, the following communication:—

TO PROF. BENJAMIN PEIRCE, *Superintendent of the Coast Survey.*

SIR:—In accordance with the vote of the Harbor Commissioners I have the honor to submit the following statement and request:—

We are in possession of three careful surveys of the inner harbor of Boston, the first executed in 1835, the second in 1847, and the third in 1861, the intervals being respectively twelve and fourteen years.

The advisory council, upon which you have been pleased to serve, made comparison among these surveys and reported upon the same (Second Annual Report of the Board of Harbor Commissioners, 1868), making exhibit of the "dangerous tendencies" of the shoaling in the harbor basin.

Twelve years have elapsed since the last survey, commented upon in your report above mentioned, was made, and the Board respect-

fully offers the suggestion, that you should consider the propriety of instituting another series of surveys, covering portions of the upper harbor and extending into the lower harbor as far as you may deem expedient.

Such re-surveys would be very opportune, because initial steps are being taken to construct the wall about South Boston flats, first recommended by the United States Commissioners.

The aforesaid United States Commissioners presumed that the construction of this wall would effect changes in the regimen of the tidal currents, and believed that these changes would be beneficial. In the twelve years, however, that have elapsed since the last survey, very considerable changes may have occurred in the bed of the harbor, and it appears to this Board that these should be ascertained before the effects of the south wall begin to be felt. Moreover, it is a part of the project for the occupation of the South Boston flats, that the filling shall principally be taken from the bed of the basin adjacent to these flats, and the Board desires to be advised as to the order in which the dredging should be done so as to be most beneficial to navigation.

This dredging, which is to be done at the expense of the State of Massachusetts, will be a direct benefit to the general government, because it will enlarge and deepen the main channel leading to the United States navy yard and increase the area of anchorage ground for large vessels.

This consideration leads the Board to hope that you will regard the proposal for a new survey with favor, and lend your personal attention to it as far as is practicable.

There are portions of the lower harbor which are known to have changed for the worse since the last survey (1863), and which, we suggest, ought to be reëxamined. Brewster Bar has continued to advance into the main channel, and some of the headlands protecting the anchorages and channels have continued to fall into the sea.

Very respectfully,

JOSIAH QUINCY, *Chairman.*

The Board has not yet received a reply to this communication, for the reason, it is informed, that it is not yet certain what amount of work the Coast Survey will be able to undertake this year.

DRAINAGE OF THE FLATS AND MARSHES OF EAST HARBOR
CREEK.

The legislature in 1872 passed the following Resolve :—

Resolved, That the board of harbor commissioners is hereby authorized and directed to consider whether the meadows and flats in Provincetown and Truro, formerly drained by East Harbor creek, can now be drained either by an outlet through the dike built across said creek by the Commonwealth under chapter eighty-six of the resolves of the year eighteen hundred and sixty-seven, or by any other means without injury to Cape Cod harbor; and in case said board shall be satisfied that such drainage can be obtained without injury to Cape Cod harbor said board is hereby authorized to construct such a work or take such measures as shall secure the drainage of said meadows and flats. And said board is hereby further authorized to compromise and settle in behalf of the Commonwealth any demands that seem to said board just claims for injury to said meadows and flats resulting from the interference of said dike with the drainage of said meadows and flats, and to execute and receive in behalf of the Commonwealth, conveyances of said meadows and flats, or any portion of them or any agreements concerning them and said claims for injury: *provided, however*, that said conveyances and agreements shall be subject to the approval of the governor and council; and there shall be allowed and paid out of the treasury of the Commonwealth for the purpose of this resolve a sum not exceeding five thousand dollars.

The Board visited the locality in 1872, and gave a hearing in Provincetown to the marsh-owners. It there appeared that the injurious effects of the dike upon the meadows were of a twofold and entirely opposite character as regards the proposed remedy of additional drainage. A portion of the marshes which before the dike was constructed were only occasionally covered by water, were now submerged all the time. Another portion of these marshes which was formerly flowed by water, is never flowed now. Before the dike was built, there was a growth of a rank sort of meadow-grass on both portions of these meadows, part of which is now too wet and another part too dry, for the grass it used to bear or any other sort of vegetation.

The loss of this crop of coarse meadow-grass was the ground of the claims upon the Commonwealth for relief.

The best effect of draining these marshes that could reasonably be expected would be to improve the productive capacity of the marshes that are too wet or entirely submerged, to injure those portions that were still productive, and make still more incapable of vegetation such portions as are now too dry.

Moreover, the Board could not be certain that the grass would re-appear on those portions of the meadows that should be drained.

The vegetation that formerly existed had probably been sustained mainly by the deposits from the waters flooding these marshes in high courses of tides, when they had free course from the harbor up the creek by its broad channel-way.

Whether the same deposits would be made with only such a sluice-way as would be sufficient for drainage, or with even a sluice-way sufficient to transmit to the marshes the full height of every tide, if such a sluice-way were consistent with the safety of Cape Cod Harbor, experiment only can demonstrate. Even if the land were restored by drainage to its former productiveness the owner would still claim damages for the loss of his annual crop while his land was unproductive. There are still other considerations which render it problematical, to say the least, what effect any drainage deemed admissible would have upon the vegetation of these marshes.

In answer to inquiries of the Board, James B. Francis, Esq., of Lowell, the engineer to whose science and practical skill the Commonwealth is indebted for the successful construction of this dike, and who accompanied the Board when it visited these marshes in August, 1872, submitted the following report :—

LOWELL, February 1, 1873.

Hon. JOSIAH QUINCY, *Chairman Board Harbor Commissioners.*

DEAR SIR :—In reply to the questions relating to the drainage of the meadows and flats in Provincetown and Truro formerly drained by East Harbor Creek, submitted for my professional opinion in your communication of the 20th of December last, I beg leave to say :—

That since the construction of the dike across the mouth of East Harbor, the water shut in, originally salt, has become fresh, or nearly so, by dilution with the rain-fall on the water-shed, the plane of the surface of the water being very near the level of half tide. I am

informed that it is subject to perceptible variations in height, depending on rain-fall and evaporation, and I have no doubt it is also subject to a minute change at every tide, resulting from a movement to and fro of the water with which a great part of the sand below the level of high water is saturated, caused by the varying height of the tide. At high tide, and a little after, the water is seen flowing in from Beach Point in a multitude of little rills, and an equal quantity must percolate out when the sea is below half tide. On the 7th of August last, soon after high tide, I observed the water flowing in as above, and was surprised to find it fresh, or nearly so. This, of course, could not come from the outside of Beach Point, where the water was salt, but must have been forced up by the pressure outside. The action, I think, must be this: at low tide the pressure is diminished and the level of the water-table in the sand of Beach Point is lowered, and the water in the sand moves seaward, a percolation at the same time taking place into the sand from the basin of nearly fresh water inside. When above half tide, the pressure and movement of water is in the opposite direction. This operation is repeated at every tide. In other words, the sand forming Beach Point contains a large volume of water, salt on the outside, and fresh, or nearly so, on the inside; and although the sand prevents the free movement of the water, the pressure is communicated, and there is a rise and fall of the water-table with every tide. At high water the level of the water-table is above the level of the water inside, and the water oozes out of the sand into East Harbor in the manner observed. At low tide the operation is reversed, the water percolating outwards, but at a lower level. There is probably a similar action between East Harbor and the outer beach, but in probably much smaller degree.

Before the construction of the dike, a shoal near the mouth of East Harbor prevented the tide in it from falling so low as in Cape Cod Harbor by about two feet in ordinary tides. Now it maintains a nearly constant level two or three feet above its former low-water level, and the object of the proposed drainage is to reduce the level of the water to a plane nearer the former low-water level.

Before the construction of the dike, nearly the whole of the flats in East Harbor were laid dry at low water, and a large part of the area produced sedge and grass of some value for agricultural purposes. Since the construction of the dike the conditions have entirely changed. Instead of the flats being covered with salt water and laid dry alternately at every tide, a part of them are now permanently dry and the remainder permanently covered with nearly fresh water. The flats laid dry being removed from the action of the salt water, the vegetation must, in time, undergo a complete

change, but whether agriculturally beneficial or otherwise I am unable to say. In the flats now permanently under water I presume no useful grasses can be produced.

The flats being so nearly level, a large area must lie so near the level of the water that vegetation would be greatly affected by it; some of it, I presume, beneficially, and some injuriously; and while the effect of lowering the plane of drainage would undoubtedly improve some parts of the flats it would injure others. That is, in these flats, composed as they are of pure sand with some decomposed vegetable matter, a plane of drainage a certain number of inches below the surface is the most favorable for agricultural purposes, and the effect of lowering the plane of drainage, as proposed, while it will improve some parts of the flats, will injure others.

The drainage, I think, can be best accomplished by means of a drain or culvert through the dike or Beach Point. What would be the most advisable plane of drainage to adopt I am unable to determine, as it involves a consideration of the agricultural advantages to be derived. I should suppose it would not be worth while to attempt to lower it more than two feet below its present level, and perhaps not more than one foot. The proper determination of the question will require a special survey and an examination by agricultural experts, and I would suggest that it be made with reference to two planes, one of them at the lowest height that might be deemed advisable, and the other at a height intermediate between that and the present level of the water. The survey would give the water-lines at the present height, and of the two planes, and the areas of flats that would be drained by each. I think it will be found that the difficulty and expense of maintenance will increase rapidly as the plane of drainage is lowered. If drained below its present level, I think the effect must be to render the water remaining more salt than it now is. At present I think there is little or no percolation of salt water through the sand of the dike and of Beach Point into East Harbor, the level being maintained by the rain-fall. If the level is materially lowered, I think percolation must take place, more or less, at every tide, an equal quantity passing out at low tide through the outlet provided for the purpose, and the effect will be to render the water inside the dike less stagnant than it now is.

The situation for the outlet should be selected with reference to freedom from obstruction of its point of discharge into Cape Cod Harbor by sand as well as to its length. For the higher of the two planes, judging from the map, I think about a mile south-east of the dike will be found a convenient point; for the lower plane, a point nearer the dike will probably be selected.

As to the construction of the outlet, I think a wooden box-drain, furnished with a tide-gate and laid at the proper grade, will be the most suitable. It will last many years, and I think it not improbable that changes will occur which, in time, will render it desirable to change its location, height or size.

The sand-hills between East Harbor flats and the outer beach are mostly bare of vegetation, and the exposed surface of sand is blown by the wind into East Harbor, the effect of which must be, in time, to fill it up. Before the construction of the dike, much of the sand thus blown into East Harbor was carried by the ebb-tide into Cape Cod Harbor. Of course this has now ceased, and I think the effect will be to fill up East Harbor with a rapidity which in a few years will make a great change. I do not see that this filling up will be materially affected by the height which may be adopted for the drainage plane. If nothing is done in the way of drainage, I think the causes now in action will gradually diminish the area of water-surface and perhaps raise its level somewhat, and it will probably become entirely fresh.

As to the effect of the drainage upon Cape Cod Harbor, I do not see anything in the scheme likely to be injurious, except that it will tend to make a breach, if one should occur, either in the dike, Beach Point, or from the outer beach, more disastrous.

A breach through Beach Point in some conjunction of a great storm and high tide I think not improbable, unless the low and narrow places in it are much strengthened. The lower the water on the inside the greater will be the flow of water through the breach to fill it, and of course the larger the channel it will cut.

Very respectfully, yours,

JAMES B. FRANCIS.

The reduction of the level of the water on these marshes by only one, or at most, two feet is all that is contemplated by Mr. Francis as worth attempting. The largest reduction leaves the level of the standing water one foot above the plane of low water before the dike was constructed, and in his judgment "it will be found that the difficulty and expense of maintenance will increase *rapidly* as the plane of drainage is lowered."

Upon the amount of the reduction of the level of the water on these marshes depends the area of marshes that will emerge from the water now covering them. Where the drain has once been built it appears from this report that "it is not improba-

ble that changes will occur which in time will render it desirable to change its location, height or size."

It further appears that these submerged marshes are gradually filling up with the sand which, before the dike was built, was carried by the tide into Cape Cod Harbor to its great injury, and that the drainage of these marshes will not make it less likely that this area of marshes will be filled up with sand.

Upon the point whether the drainage of these marshes in the only way feasible, will injure Cape Cod Harbor, while Mr. Francis does not think that under ordinary circumstances it would prove injurious, he is still of the opinion that there are exceptional circumstances not unlikely to occur where a drain would have a bad effect. "It will tend," he says, "to make a breach, if one should occur either in the dike, Beach Point or from the outer beach, more disastrous.

"A breach through Beach Point in some conjunction of a great storm and high tide, I think not improbable, unless the low and narrow places in it are much strengthened. The lower the water on the inside, the greater will be the flow of water through the breach to fill it, and of course the larger the channel it will cut."

For the purpose of ascertaining what, in the deliberate judgment of the marsh-owners, was the amount of the damage they had sustained, the Board invited them to appoint a committee who should estimate it. They did so, and the following is the report of this committee:—

We, the undersigned, being a Committee chosen to estimate the damages done to Eastern Harbor meadow by building a dike across the channel for the preservation of Provicetown Harbor, do make the following report:

We commenced at the head of the north branch and examined each piece separately; also Moon Pond and seven lots in Cedar Islands, containing in all two hundred and sixty-one acres; and we appraised the damage to the same at an average of twenty-seven dollars and fifteen cents per acre, some more and some less, according to the damage done, the whole amount being \$7,087.87 (seven thousand and eighty-seven dollars and eighty-seven cents). There is a large lot of meadow situated in Cedar Island that your Committee don't know the owners nor the bounds to the same, but as it

has not been considered of any value to the owners for the last fifteen years, we concluded that the damage is not much, if any.

WILLIAM HOLDEN,
JOHN SMITH,
THOMAS F. SMALL,
THOMAS K. SMALL,
Committee.

This estimate does not include claims amounting to two or three thousand dollars made in a corporate capacity by proprietors of the East Harbor beaches and marshes. The cost of building the drain would probably be about three thousand dollars.

Such being the state of the case, the Board do not advise the drainage of these marshes. It recommends that the Commonwealth satisfy these claims for damages. If the difference between the amount of their claims and the value of the land should prove not to be much, it might be expedient, in view of the possibility that other action affecting this property may become necessary hereafter for the protection of Cape Cod Harbor, for the State to purchase the whole territory in relation to which these claims are made.

The Board advises the payment of a proper amount in settlement of existing claims rather than drainage, for these reasons,—

First,—Drainage will cause new claims for damages because it will render unproductive, marsh-land that is now productive.

Second,—It is not certain that drainage would restore the former productiveness.

Third,—Drainage will not compensate for crops already lost, even if the productiveness of the land were restored; there will still be a claim for a money compensation for past losses, even if the productiveness of the marshes were restored.

Fourth,—The drain becomes a structure which the Commonwealth would be bound to maintain and keep in repair, and would be a continual source of expense, and it is not unlikely it would have to be rebuilt in a different location.

Fifth,—A drain through Beach Point, where it must be located, might, in certain contingencies not unlikely to happen, prove a source of injury to Cape Cod Harbor.

The marsh-owners have refused to settle their claims for five thousand dollars, the amount of the appropriation, and the Board has taken no further action in the premises.

MALDEN RIVER.

The legislature of 1873 passed the following Resolve:—

Resolved, That the harbor commissioners inquire into the expediency and feasibility of straightening and deepening the channel of Malden River between the head of navigation and Mystic River, and that if, in their judgment, such improvement is advisable, they report to the next legislature, during the first week of the session, a plan for such improvement, showing the probable expense thereof and how such expense should be borne.

The Board has given several hearings upon the proposed improvement of Malden River, mainly, however, to citizens of Malden who are chiefly interested in the matter. It also caused a plan to be made showing the cuts through the marshes necessary to secure the straightening of the river, and as a basis for the estimates of the cost of the work. To execute this plan so as to continue to Malden the depth of Mystic River, about eight feet at mean low water, it would require the excavation through the marshes of cuts from 140 to 200 feet wide, and of an aggregate length of about 5,500 feet.

The cost of this excavation, assuming that the material could be deposited on the neighboring territory or ultimately used to fill up the portions of the river-channels from which the water would be diverted, is estimated at \$152,000, reckoning the cost of excavation at forty cents per cubic yard, and at \$114,000 on the basis of thirty cents per cubic yard.

In addition to the cost of excavation it would be necessary to reckon the cost of closing up the portions of the channel to be discontinued, to insure the diversion of the water into the new water-course. Besides this, there should be estimated the claims for damages which marsh-owners would make whose estates had bordered on the old channel, and who, by the diversion of the water into new courses, would have lost their water-fronts. One hundred and twenty thousand dollars would probably be the lowest sum for which the work could be done.

That the improvement is possible admits of no question. It only requires cuts of proper extent through soft marsh-land, in which it is not probable any ledge would be found, and the closing up of the portions of the channel to be severed from the new line of the river. Whether the improvement is expedient or advisable depends upon whether the advantages secured by it are worth the cost to the party that is to pay the cost.

These advantages are simply those that result from a reduction of the length of Malden River as a highway of commerce from 5,500 to 4,700 feet, a saving in distance of seventeen per centum. Now the party to be benefited by this improvement is the town of Malden, or the interests that centre in this town.

The town of Everett would not be appreciably benefited by the change. Its interests are in a very slight degree connected with the navigation of Malden River. The people of Malden have had several meetings to consult upon this matter, and representative citizens of Malden, among them especially Mr. Benjamin Faulkner, chairman of the selectmen, have appeared before the Board, and they decline to contribute anything to the proposed improvement, although recognizing that it would be a great benefit to the town.

Whether it is expedient or advisable for the people of Malden to make this improvement, the Board will not assume to judge.

A charter was long since granted by the legislature for doing this very work, but the local benefit has not heretofore been felt to be such as would justify its execution as a local measure. But if not expedient or advisable as a local measure, it is not, in the judgment of the Board, expedient or advisable at all. Certainly no reason can be given why the State should contribute anything towards it but the requisite legislative authority, such as has already been accorded. It has been suggested that the United States has on this river a depository for its saltpetre, and in this way has an interest in this improvement. If Congress can be persuaded that this interest is sufficiently great to warrant an appropriation to pay the cost of the work, the town of Malden will be greatly benefited.

Not deeming it advisable or expedient that the Common-

wealth should undertake this improvement, and the only party that, in the judgment of this Board, should bear the principal portion of the expense of it, if it should be undertaken, having declined to bear any part of this expense, the Board does not report such improvement advisable, and submits no plan for it to the legislature.

COTAMY BAY.

The work of re-opening an outlet from Cotamy Bay through Cotamy Beach to the ocean to maintain the tidal circulation upon which the existence of Edgartown Harbor depends, and for which Congress, in response to the memorial of this Board, made an appropriation of \$20,000, was assigned by the government to Gen. Geo. K. Warren, U. S. engineer, and the work was undertaken by him during the past year, but has not, thus far, resulted successfully. The Board has unabated confidence, however, that the project is feasible. It has no doubt of Gen. Warren's final success, and hopes that the government will authorize him to renew his operations in the course of the present year. The Board regrets its inability to append Gen. Warren's report on this work, but it has not yet been made.

LEGAL PROCEEDINGS.

The information against the Boston and Lowell Railroad Corporation to restrain it from building a sea-wall and filling flats in Miller's River has been heard and reported to the full bench. It is expected that the case will be argued this winter.

The information against the trustees of the Boston, Hartford and Erie Railroad Company has not advanced beyond the preliminary hearing stated in the last report. It is exceedingly desirable, for many reasons, that such action might be taken for the improvement of South Bay as would relieve the Board of the necessity of insisting, by the prosecution of this information, that a considerable portion of this railroad within the limits of South Bay should be on piles instead of the solid filling that has been unlawfully put into the bay. These trustees desire the railroad across this bay to be on a solid embankment. The city of Boston desire the extension of Swett

Street solid across another portion of South Bay. Sanitary considerations require that South Bay should be deepened so that its flats, impregnated with sewage matter, should not be exposed at every low tide to the sun. Commerce needs deeper water in South Bay. The westerly portion of the bay can only be deepened economically by using the material dredged out in filling up so much of the bay as lies east of the railroad. Such an excavation and filling would harmonize all interests. It has heretofore proved impossible to unite all interests connected with this bay in a plan for executing this improvement. Were the city of Boston invested with the requisite power in the premises, so that it could do the work itself, a union of all interests centering here might, perhaps, be effected. If it could be accomplished in no other way, the city, it is believed, could do the work itself, without ultimate loss to its treasury, and secure a great public benefit. The wharf-owners on South Bay could well afford to submit to be assessed for a betterment to their estates resulting from such an improvement of this commercial basin and their water-frontage upon it.

The Board has also requested the district-attorney for Suffolk County to indict George W. Gerrish for unlawfully building a wharf in Chelsea, in violation of the fourth and fifth sections of chapter 149 of the Acts of the year 1866.

An information, at the relation of this Board, has been filed by the attorney-general in regard to the Eastern Railroad Company for building a bridge over Prison Point Bay before having its plans for the structure and its location approved by the Board. The only difficulty the Board had in approving the plans and location submitted, arose from the fact that the location of the bridge was such as to carry the road through what the attorney-general of the Commonwealth claimed was the inclosure of the state prison in Charlestown, and what, at a subsequent hearing in the supreme judicial court on a proceeding begun by the company to enjoin the warden of the state prison from resisting the construction of the company's road through the prison yard, Chief Justice Gray decided was the inclosure. The Act, however, which authorized the company to locate and construct its road, expressly excluded the company from the inclosure of the state prison.

SHOALS OFF CONSTITUTION WHARF IN BOSTON HARBOR.

Notice having been given to the Board that the harbor frontage off Constitution Wharf had been shoaling up, the Board directed that a survey should be made to ascertain what foundation there might be for these representations. This survey, and a comparison of its results with the general survey of 1861, prove that there has been no diminution of the depth of water in this locality. The belief to the contrary has doubtless originated in the fact that the vessels frequenting this water-front have a greater draught of water now than formerly. To adapt this portion of the harbor to the present demands of commerce, a considerable amount of dredging should be done in this locality.

To ascertain the amount of material it was desirable to have removed, Prof. Henry Mitchell, of the U. S. Advisory Council, made an investigation, at the request of the Board, and the following is his report :—

In compliance with the vote of the Board, passed 26th December, requesting me “to estimate the amount of dredging required to accommodate vessels of the largest class at the channel off Constitution Wharf,” I have the honor to make the following report :—

Vessels of the largest class that can enter the Upper Harbor of Boston, at ordinary low water, draw 23 feet; and this depth can now be carried up the channel past Constitution Wharf, and within 150 feet of said wharf. There are, however, shoals which interfere with the convenient manœuvring of a heavy ship in this neighborhood, and it is to these obstructions that Prof. Whiting refers in his report of the 24th inst., in the following words :—

“I would, however, call the attention of the Board to the largely increased size of some of the vessels which now enter the harbor of Boston, and particularly to the English steamer, ‘Lord Clive,’ which is one of the largest ships afloat, being about 420 feet long. This steamer reaches entirely across the channel; in fact, overreaches upon the shoal ground on either side of it about fifty feet,” etc.

The “*channel*” that Prof. Whiting refers to in the above quotation is the narrow pass between the “Junction Shoal” (as we have usually called it) and the aproning of shallow ground which extends from the city front at the North End. This channel, although much narrower than the one beyond the shoal, along the East

Boston front, is no less important, because it is the more direct avenue to the Charles River. It has, throughout its whole length, 23 feet and upwards, at ordinary low water, except at one point where a narrow bar, of 21 feet water, stretches across it above Chelsea Ferry.

The water-way between Boston and East Boston finds its least width in the neighborhood of Constitution Wharf, but it is nowhere less than 1,450 feet, which is ample, in every respect, *at high water*, when the least depth over the whole space exceeds 23 feet. At the time of low tide, however, the Junction Shoal divides this water-way into two channels (for heavy ships), respectively 160 and 640 feet in width, measured between the 23-foot curves,—neither of which is really sufficient for the winding of a first-class steamship.

The aproning of shallow ground extending from the North End, to which I have referred above, may be defined as lying along the city front, from a point about 600 feet below Charlestown Bridge to the lower corner of the South Battery Wharf, and protruding into the stream, off Comey's Wharf, about 600 feet at the broadest point. Since the earliest reliable surveys it has remained essentially the same, although some slight shoaling, off Constitution Wharf, occurred between 1837 and 1861, as shown in the report of the U. S. Advisory Council, published by the Board in 1868.

The removal of this entire aproning would be of immense advantage,—*improving at once channel and frontage*,—but would involve dredging to the amount of 111,000 cubic yards. If the approaches to Constitution Wharf only are considered, the amount of excavation sinks to but 7,036 cubic yards—from the space outside of the Commissioners' line between Chelsea Ferry and North Battery Wharf.

In order to remove the worst part of the Junction Shoal, from its southern end to the 21-foot slue-way, dredging must be done over an area of 11 acres, and excavation to the amount of 53,333 cubic yards. If, however, only such portions are to be removed as may be essential to the manœuvring of a heavy steamer entering or leaving the docks at Constitution Wharf, the amount of dredging need not exceed 36,000 cubic yards, and this may be so done as to be a great general benefit to commerce.

HENRY MITCHELL.

TO HON. JOSIAH QUINCY, *Chairman of the Board of Harbor Commissioners.*

DEC. 31st, 1873.

The Board is of the opinion that the income of the compensation fund for Boston Harbor, accruing during the year 1874, might be advantageously applied in removing such por-

tions of the shoal off Constitution Wharf as interfere with the manœuvering here of steamers of the largest class, and recommends that the legislature authorize the Board to make such an expenditure.

COMPENSATION FUND FOR BOSTON HARBOR.

The following statement represents the state of the Compensation Fund for Boston Harbor, and the receipts for the year 1873, for tide-water displaced.

Cash on hand January 1, 1873, \$11,430 06

RECEIPTS in 1873 of the following named parties, for tide-water displaced :—

Fitchburg Railroad Co.,	\$119 43	
Boston Gas-Light Co.,	1,899 21	
Nathaniel Winsor,	53 18	
Boston and Maine Railroad Co.,	713 84	
City of Boston,	71,837 93	
Letherbee Brothers,	70 73	
Owners of Damon's Wharf,	10 00	
A. R. Whitaker,	73 13	
A. & A. R. Whitaker,	189 67	
J. F. Paul & Co.,	189 81	
W. G. Coulburn for interest collected,	3 80	
David Snow,	525 00	
Malachi Clark,	75 00	
Magee Furnace Co.,	805 62	
City of Chelsea,	2 61	
Proprietors T Wharf,	22 50	
Fitchburg Railroad Co.,	28 50	
Town of Medford,	6 75	
	<hr/>	76,626 71
		<hr/>
		\$88,056 77

COMMONWEALTH'S TIDE-LANDS.

The following amounts have been paid during the past year by the parties named for wharf privileges granted by the legislature and this Board in valuable tide-lands of the Commonwealth :—

Lowell Railroad Corporation, for extension of bridge in Charles River, Boston,	\$6,025 00
David Chapin and Others, for extension of wharf in Fort Point Channel, Boston,	3,691 50
	<hr/>
	\$9,716 50

The Board respectfully renews the recommendation contained in its seventh report, that a general law be passed for securing to the treasury of the Commonwealth the pecuniary value of the privileges granted by the legislature and this Board in tide-lands of the State.

GOVERNMENT WORK TO IMPROVE AND PROTECT NAVIGABLE WATERS OF THE COMMONWEALTH.

By the usual courtesy of Gen. Humphreys, Chief of U. S. Engineers, the Board is able to append the report of Gen. Thom, of the U. S. Engineers, who has had charge during the past year of all government work connected with the improvement and protection of the navigable waters of the Commonwealth, except the work at Cotamy Bay already referred to. It is fortunate for the Commonwealth that these important interests are in the hands of so energetic and faithful an officer. This work now in progress on the coast of the State is one of many indications of a return of maritime commerce to several old seaports which were deserted in consequence of the concentration of commerce in a few large ports, that followed the establishment of the first great lines of railroad. The multiplication of railroads is now bringing back a portion of the traffic that railroads first took away.

It is a matter of deep regret to the Board that the same report of Gen. Thom that states the details of the extensive government works and expenditures for the improvement of Boston Harbor, should contain an account of a serious injury to this principal harbor of the State, traced to the action of past city governments.

CHATHAM AND MONOMOY.

Some additional information concerning the wear of the sea along the coast, at the elbow of Cape Cod, is furnished by Prof. Mitchell, whose paper, published in the last annual report of this Board, interested many on this topic. A survey recently made shows that the strip of beach lying in front of Chatham has lost fifty-six acres during the past year, and that this barrier, which once so effectually protected the uplands upon which the town is built, is being rapidly destroyed.

Although the sea has made no important inroad upon the town-front during the past year, considerable apprehension is felt, and some of the more exposed buildings have been moved back. It would seem that this quiet corner of the Cape, settled early in the history of Massachusetts, and famous for the good seamen that it has sent all over the world, is doomed to an invasion of the sea, which may destroy its harbor before many years, and verify the prophetic name given to it by the Dutch, "*Ongeluckige Haven*."

The Coast Survey has had a party at work sounding over the Monomoy Shoals during the past two years, under the command of F. D. Granger, Esq., who was instructed to act under advice from Prof. Mitchell, because of the evident connection between the changes of the shoals and the movements of the adjacent beaches.

The fleet that passes through Nantucket Sound, and past these dangerous shoals, is said to be the largest in the world; and, judging from the reports of ship-masters, the Board is much impressed with the importance of having the chart brought up to date.

It had hoped to be furnished, in time for this Report, with the results of the new survey, but the party got back late in the season and the plotting is not yet completed.

Prof. Mitchell's report, in the Appendix, is accompanied by two plates of great interest. One of these is a series of comparative maps, showing the progress of the changes at Chatham, drawn by Mr. H. L. Marindin; the other is a traditional map of Chatham and Monomoy, compiled by Capt. George Eldridge, the well-known chart publisher.

The Board is indebted to Prof. Peirce, the Superintendent of the Coast Survey, for prompt compliance with all its requests for information.

HARBOR-LINE IN GLOUCESTER HARBOR.

This Board was authorized by chap. 366 of the Acts of the year 1873, to modify a portion of the harbor-line in Gloucester Harbor, and authorize shore-owners to extend their wharves to the new frontage. License has been given for the extension of one wharf to the new line. It is desirable, however, that the establishment of a harbor-line should be authenticated

by a statute of the Commonwealth rather than the records of this Board. An amendment of sect. 2, chapter 124, of the Acts of 1866 making this change in the harbor-line of Gloucester is appended, and respectfully submitted for enactment.

OTHER WORK OF THE BOARD.

Other transactions of the Board, together with the engineering and office work, are indicated in the following statements:—

Legislative Committee Hearings.

1873.

- | | | |
|------|-----|---|
| Jan. | 21. | 1. On the petition of Cambridge, relating to Charles River Basin. |
| | 22. | 2. Town of Brookline, for liberty to divert the waters of Muddy River. |
| | 22. | 3. Henry M. Cross, of Newburyport, for leave to extend his wharf. |
| | 23. | 4. On the petition of Cambridge, relating to Charles River Basin. |
| | 28. | 5. Mystic River Corporation, for leave to extend its docks through and above Chelsea Bridge, and construct a draw in said bridge. |
| | 28. | 6. On the petition of William Humphreys and W. S. Twisden, to extend their wharf in Marblehead. |
| Feb. | 4. | 7. Charles River Basin. |
| | 4. | 8. C. A. Bartol, for a causeway across an arm of the sea at Manchester. |
| | 4. | 9. Benj. D. Dixie, for leave to extend a wharf in Marblehead. |
| | 4. | 10. American Print Works Company, for leave to extend a wharf in Fall River. |
| | 4. | 11. On an Act relating to the Boston and Lowell Freight Bridge across Charles River. |
| | 4. | 12. William Lewis, to extend a wharf in Vineyard Haven. |
| | 4. | 13. Job T. Wilson, for leave to construct a wharf in Fall River. |
| | 7. | 14. Mystic River Corporation. |
| | 7. | 15. Boston and Lowell Railroad, concerning Freight Bridge. |
| | 11. | 16. Charles River Basin. |
| | 11. | 17. Hearing before the Governor's Council on Harbors about wharf extensions in Fort Point Channel. |

- Feb. 11. 18. City of Newburyport, to maintain and extend wharves.
12. 19. Town of Nahant, for leave to construct a wharf.
12. 20. J. F. Dodge, for leave to build a wharf at Squantum.
12. 21. Owen Bearse, for leave to build a wharf at Squantum.
12. 22. Humphrey and Twisden, for leave to build a wharf at Marblehead.
12. 23. Barnabas Clark, for leave to build a wharf at Fall River.
12. 24. Cook Borden, for leave to build a wharf at Fall River.
12. 25. Daniel Ward, of Scituate, for leave to take gravel from the beach.
18. 26. C. A. Bartol, for leave to construct a causeway at Manchester.
18. 27. Job T. Wilson, for leave to construct a wharf at Fall River.
18. { 28. Boston and Maine R. R. Co., for leave to construct
29. Wharves in Mystic River, also to cover flats in Charles and Miller's rivers.
19. 30. Town of Nahant, for leave to construct a wharf.
20. 31. Mystic River Corporation, for draws.
20. 32. Boston and Lowell R. R. Corp., building on Freight Bridge.
26. 33. Robert Hooper and others, of Gloucester, for repeal of an Act concerning Granite Cove.
26. 34. Boston and Albany R. R., for extension of time for payment of money for flats on South Boston flats.
27. 35. Boston Land Co., for leave to fill flats.
27. 36. Town of Medford, for leave to build a bridge across Mystic River.
28. 37. City of Haverhill, for leave to build a wharf, etc.
28. 38. E. C. Kelley, of Newburyport, for leave to fill flats.
28. 39. M. E. Hale, of Newburyport, for leave to fill flats.
- Mar. 5. 40. C. A. Bartol, for leave to construct a causeway at Manchester.
5. 41. E. H. and M. F. Stanwood, to build a wharf in Ipswich.
5. 42. E. T. Ingalls and A. R. Kimball, to build a wharf in Haverhill.
5. 43. Warren Ordway, to build a wharf in Haverhill.

- Mar. 5. 44. James Ritchie, to build a wharf in South Dartmouth.
6. 45. Old Colony Railroad, for leave to widen its bridge across Fort Point Channel.
6. 46. Cary Improvement Co., to build a bridge across Chelsea Creek.
7. 47. Commissioners on West Boston and Cragie bridges, for leave to widen Cragie Bridge.
7. 48. Eastern R. R. Co., for leave to widen its bridges over Charles and Miller's rivers.
7. 49. Holmes' Hole Union Wharf Co., for leave to extend wharf in Vineyard Haven.
11. 50. City of Haverhill, for leave to construct a wharf and build an arch over Little River.
12. 51. Boston Land Company, for authority to fill flats.
12. 52. Cary Improvement Co., for leave to construct a bridge across Chelsea Creek.
13. 53. Old Colony R. R. Co., to widen its bridge on Fort Point Channel.
13. 54. Hearing on the establishment of harbor-lines in Neponset River. At the office of the Board.
18. 55. On Harbor Commissioners' Report.
20. 56. Rev. C. Bartol, for a causeway in Manchester.
22. 57. Hearing of the towns of Bradford and Haverhill for the construction of a new bridge across Merrimac River, between said towns.
25. 58. Mayor of Somerville, for leave to fill flats in Miller's River Basins.
- April 1. 59. Boston Land Company, for leave to fill flats.
2. 60. Boston and Maine R. R. Co., to construct wharves on Mystic River.
8. 61. Boston and Maine R. R. Co., for authority to fill flats in Charles and Miller's rivers.
8. 62. Eastern R. R. Co., to widen its bridges over Charles and Miller's rivers.

Hearings before the Board.

One hearing with the Old Colony & Newport Railroad officials concerning location of bridge across Taunton River between Fall River and Somerset.

Three hearings with commissioners on Cragie Bridge about reconstructing said bridge.

One hearing with trustees of Boston, Hartford & Erie Railroad Company concerning filling solid of bridge in South Bay.

One hearing with Boston Gas-Light Company in regard to com-

pensation for tide-water displaced, to be paid by said company for wharf-structure in Charles River.

Three hearings with Thomas H. Russell in relation to the extension of Liverpool, Curtis's and Wiswell's wharves in Fort Point Channel.

Two hearings with the city of Haverhill and the town of Bradford concerning reconstruction of bridge between Bradford and Haverhill.

One hearing concerning the establishment of harbor-lines in Neponset River.

Three hearings with George W. Gerrish concerning the building of a wharf in Chelsea, without authority from the Board.

Two hearings on the establishment of a harbor-line in Newburyport Harbor.

One hearing with Boston Gas-Light Company about wharf-extension on Commercial Point.

One hearing with County Commissioners of Bristol County concerning bridge across Taunton River between Berkley and Dighton.

One hearing with City Solicitor of Boston concerning the extension of Fort Hill Wharf.

Two hearings with Old Colony & Newport Railroad Company and citizens of Sandwich and Truro concerning bridges across Monument and Pamet rivers.

Two hearings with the city of Charlestown concerning the displacement of tide-water by the building of Canal Street across Prison Point Bay.

Four hearings on the petition of Fred. Pope and others to occupy the water-front to the commissioners' line between Cragie and West Boston bridges in Cambridge.

Two hearings with Bay State Iron Company for leave to extend its wharves in South Boston.

Two hearings on the subject of improving Malden River according to the provisions of chapter thirty-three of the Resolves of 1873.

One hearing on the petition of the Eastern Railroad Company for leave to build a crib-wharf in Salem Harbor.

Two hearings on the petition of James N. Buffum for leave to extend his wharf in Lynn Harbor.

One hearing on the petition of Harrison Parker for leave to extend his wharf in Mystic River.

One hearing with Committee on Streets of the city of Boston in regard to the location of Eastern Avenue.

Three hearings on the petition of the Eastern Railroad Company for leave to build a bridge across Prison Point Bay, Charlestown.

Two hearings on a complaint of General Thom in regard to the taking of gravel from Plymouth and Duxbury beaches.

One hearing with selectmen, road commissioners and citizens of Manchester in regard to building a bridge across Edwards Creek, in Manchester Harbor.

The Board made personal visits to Mystic River, Prison Point Bay, South Boston flats, Long Island (Boston Harbor), Monument River, Pamet River, Provincetown and Washington.

Maps and Plans.

Maps for annual report and tracings of the same.

One plan showing drawbridge and causeway of the Boston, Hartford & Erie Railroad in South Bay.

One plan of the triangular piece of the Boston & Lowell Railroad Corporation between their two passenger bridges in Charles River.

One plan showing proposed extension of wharf in Fall River for legislative committee on harbors.

One plan showing proposed extension of wharf in Fall River by Job T. Wilson, for legislative committee on harbors.

One plan showing extension of wharf in Newburyport by C. J. Brockway, for legislative committee on harbors.

One plan showing the location of draws of the Boston & Lowell Railroad Corporation in their Charles River bridges.

One large plan showing wharf facilities in Boston Harbor, for legislative committee on railways.

One plan showing Arsenal Street drawbridge between Brighton and Watertown.

One plan showing harbor-lines established in Newburyport Harbor.

Four plans to accompany specifications of the work to be done on South Boston flats.

One plan showing heavy sea-wall to be built on South Boston flats.

Two plans illustrating the surveys off Constitution Wharf, made in 1861 and 1873.

Also the plotting and mapping of the different other surveys of minor matters.

Field-work during the Year 1873.

1. Survey of drawbridge and causeway of the Boston, Hartford & Erie Railroad in South Bay, both topographical and hydrographical.

2. Survey in Newburyport and examination of location of Newburyport City Railroad across tide-water, along the waterfront of Newburyport Harbor; also survey for wharf-extension.
3. Survey in Taunton River at Fall River for determination of channel and wharf extensions of Cook Borden and Barnabas Clark.
4. Inspection and investigation of proposed wharf-extension of C. J. Brockway, in Newburyport Harbor.
5. Inspection of wharf-extension of Job T. Wilson, in Fall River.
6. Survey in Chelsea Creek; determination of harbor-line.
7. Survey in Newburyport Harbor; determination of a ledge in front of Mooney's Wharf.
8. Survey of Arsenal Street drawbridge between Brighton and Watertown.
9. Survey in South Bay for the purpose of assessing compensation for tide-water displaced.
10. Survey in Chelsea to ascertain the amount of filling in G. W. Gerrish's Wharf.
11. Survey of beach near Shirley Point, Boston Harbor.
12. Inspection of location of the New Bedford Railway Company across tide-water in New Bedford Harbor.
13. Survey in Chelsea concerning wharf-extension of J. Campbell.
15. Inspection and examination of "Long Point," in Salem Harbor, at the request of the Board of Trade; also for wharf-extension by Salem Gas-Light Company.
16. Examination in Fall River in relation to depositing dredged material in Mount Hope Bay, at the request of citizens of Fall River.
17. Examinations in Gloucester and Salem about wharf-extensions.
18. Examination in Salem Harbor about wharf-extension by the Eastern Railroad Company.
19. Inspection of the beach on south side of Long Island, Boston Harbor, in relation to the taking gravel of from said beach.
20. Survey in Gloucester in relation to a change in the harbor-line.
21. Examination in Somerset in relation to dumping dredged material in Taunton River, at the request of citizens of Somerset.
22. Examination of territory filled by the Boston and Lowell Railroad Company in Charles and Miller's rivers.
23. Examination in Salem Harbor about wharf-extension by S. Flint.
24. Survey of the low-water line in front of Foster's and Packard's wharves, in Boston Harbor.
25. Examinations in Salem and Gloucester for wharf-extensions.

26. Examination of Pratt's Wharf in Neponset River.
27. Survey of shoals off Constitution Wharf, in Boston Harbor.
28. Survey on South Boston flats, marking of the extension line of solid filling by driving piles for the use of the contractors.
29. Survey in Lynn Harbor in relation to wharf-extension by James N. Buffum.
30. Examination of the Boston Land Improvement Company's land, flats and the proposed improvements thereon.
31. Surveys in South Bay, Fort Point Channel, Boston Harbor, Chelsea Creek, Charles and Miller's rivers for the purpose of assessing compensation to different parties.

Plans approved by the Board of Harbor Commissioners during the year 1873, for the erection of structures in or over Tide-water, and Licenses granted for such structures.

1. Town of Medford, for the construction of a bridge across Mystic River, in the extension of Auburn Street. Approved January 1, 1873.
2. Boston and Lowell Railroad Corporation, for authority to widen and build new draws in its bridges on Charles River. Approved January 1, 1873.
3. Charles H. Bacon, for leave to construct a pile-wharf in South Bay. Approved January 1, 1873.
4. Boston and Maine Railroad Company, for leave to widen and build a new draw in its bridge over Miller's River. Approved January 8, 1873.
5. Boston and Albany Railroad Company, for leave to extend its grain-elevator on its wharf in East Boston. Approved January 15, 1873.
6. Old Colony Railroad Company, for location of its railroad bridge, crossing Taunton River between Fall River and Somerset, near Slade's Ferry. Approved January 15, 1873.
7. Long Wharf Corporation, for leave to straighten the line on the easterly end of its wharf. Approved January 15, 1873.
8. Fitchburg Railroad Company, for leave to drive additional piles for the foundation of derricks in its wharf on Miller's River. Approved January 15, 1873.
9. Trustees under the Berdell mortgage of the Boston, Hartford and Erie Railroad Company, for leave to extend its wharf in Fort Point Channel, on the north-easterly side. Approved January 29, 1873.
10. Simeon Flint, for leave to extend his wharf in South River, Salem Harbor. Approved February 5, 1873.

11. Benjamin Randall, for leave to build a wharf in Chelsea Creek. Approved February 5, 1873.
12. Richard Olney, for leave to fill certain parts of Howe's Wharf, in Fort Point Channel. Approved February 12, 1873.
13. William Parsons, 2d, for leave to construct a sea-wall under his pile-wharf in Gloucester Harbor. Approved February 12, 1873.
14. Miles Pratt and Company, for leave to extend their wharf in Charles River, Watertown. Approved February 19, 1873.
15. Richard Olney, for leave to extend his wharf on piles, in Fort Point Channel. Approved February 19, 1873.
16. Boston and Lowell Railroad Corporation, for the occupation of the triangular space between the locations of their passenger bridges, in Charles River. Approved March 5, 1873.
17. William Parsons, 2d, for leave to extend his wharf, for the foundation of a salt store, Gloucester Harbor. Approved March 12, 1873.
18. Thomas Cunningham, for leave to build a pile-wharf in Chelsea Creek. Approved March 17, 1873.
19. Choate Burnham, for leave to fill solid the westerly extension of the line of Sixth Street, South Boston. Approved March 26, 1873.
20. Owners of Liverpool Wharf, for leave to extend Liverpool Wharf. Approved March 29, 1873.
21. Boston and Maine Railroad Company, for leave to build a wharf on the southerly side of Miller's River, on the easterly side of its bridge. Approved April 2, 1873.
22. Commissioners on West Boston and Cragie bridges, for leave to drive twenty-six piles in the southerly portion of the draw-pier of the West Boston Bridge, for the support of an engine-house. Approved March 29, 1873.
23. Magee Furnace Company, for leave to extend its wharf in Chelsea Creek. Approved April 9, 1873.
24. Edward F. Wiswall, for leave to extend his wharf in Fort Point Channel. Approved April 9, 1873.
25. Nathaniel Winsor, for leave to extend his wharf in Fort Point Channel. Approved April 9, 1873.
26. City of Boston, for leave to rebuild Chelsea Street Bridge. Approved April 9, 1873.
27. James Powers and Company, for leave to extend their wharf to the commissioners' line in Fort Point Channel. Approved April 16, 1873.
28. City of Haverhill, for leave to build a new bridge in place of the old one, between Bradford and Haverhill. Approved April 23, 1873.

29. William S. Coffing, for leave to build a spur track to connect his wharf with City Railroad, Newburyport. Approved April 30, 1873.
30. Old Colony and Newport Railroad Company, for leave to build a new and extend another wharf in Taunton Great River, at Somerset. Approved May 7, 1873.
31. Thomas Cunningham, for leave to fill solid a portion of his wharf in Chelsea Creek. Approved May 14, 1873.
32. Boston and Maine Railroad Company, for leave to build a belt around its flats in Mystic River. Approved May 14, 1873.
33. J. Campbell, for leave to extend his wharf in Chelsea. Approved May 14, 1873.
34. Salem Gas-Light Company, for leave to construct a wharf in Salem Harbor. Approved May 21, 1873.
35. Sidney Friend and Brothers, for leave to extend their wharf in Gloucester Harbor. Approved May 28, 1873.
36. Proprietors of T Wharf, for leave to extend their wharf on the northerly side. Approved May 28, 1873.
37. Joseph A. Procter, for leave to extend his wharf in Gloucester Harbor. Approved June 4, 1873.
38. Gardner Prouty, for leave to extend Damon's Wharf, in Charlestown, on both sides. Approved June 4, 1873.
39. Boston and Maine Railroad Company, for leave to construct a retaining-wall on the westerly line of their location of bridge, in Mystic River. Approved June 4, 1873.
40. South Boston Iron Company, for leave to extend its wharf in Fort Point Channel to the commissioners' line. Approved June 4, 1873.
41. Pigeon Hill Granite Company, for leave to build a breakwater and wharf in Rockport Harbor. Approved June 18, 1873.
42. American Print Works, for leave to extend and enlarge its wharves in Fall River. Approved June 11, 1873.
43. County Commissioners of Bristol County, for leave to construct a bridge across Taunton River, between Berkley and Dighton. Approved June 18, 1873.
44. New Bedford Railroad Company, for leave to extend its track across tide-water in New Bedford Harbor. Approved June 18, 1873.
45. Naumkeag Steam Cotton Company, for leave to construct a stone pumping-cistern in Salem Harbor. Approved June 28, 1873.
46. Eastern Railroad Company, for leave to build a wharf in Salem Harbor. Approved June 28, 1873.

47. Edward P. Haskell, for leave to make solid a portion of his dock in New Bedford Harbor. Approved June 28, 1873.
48. W. R. Clark, for leave to build a platform between Foster's wharves, Boston Harbor. Approved June 28, 1873.
49. David Snow, for leave to extend Packard's Wharf, and also cover a portion of the dock between Packard's and Arch wharves. Approved June 28, 1873.
50. New York and New England Railroad Company, for leave to construct a trestle outside of their present bridge in Fort Point Channel. Approved July 2, 1873.
51. John Pew, of Gloucester, for leave to extend his wharf to the commissioners' line. Approved July 2, 1873.
52. Philadelphia and Reading Coal and Iron Company, for leave to extend its wharf in Newburyport. Approved July 2, 1873.
53. Choate Burnham and others, for leave to fill on the westerly extension of Ninth Street, South Boston. Approved July 9, 1873.
54. Simeon Flint, for leave to modify the line of his sea-wall in Salem Harbor. Approved July 9, 1873.
55. Boston Yacht Club, for leave to build a wharf in South Boston. Approved July 23, 1873.
56. Cook Borden, for leave to extend his wharf in Fall River. Approved July 30, 1873.
57. Old Colony Railroad Company, for leave to extend its wharf in Provincetown. Approved July 30, 1873.
58. Union Wharf Company, for leave to extend its wharf in Vineyard Haven. Approved July 30, 1873.
59. Barnabas Clark, for leave to extend his wharf in Fall River. Approved August 13, 1873.
60. Salem Gas-Light Company, for leave to change the line of its wharf in Salem Harbor. Approved August 27, 1873.
61. Stickney and Bower, for leave to extend their wharf in Taunton Great River, Fall River. Approved September 3, 1873.
62. City of Chelsea, for leave to rebuild the draw-pier in Chelsea Bridge. Approved September 25, 1873.
63. Addison Gilbert, for leave to cover a part of his dock in Gloucester Harbor. Approved October 16, 1873.
64. Harrison Parker, for leave to extend his wharf in Mystic River, Charlestown. Approved October 29, 1873.
65. Eastern Railroad Company, for leave to build a wharf, partly solid and partly on piles, in Salem Harbor. Approved October 31, 1873.
66. James N. Buffum, for leave to extend his wharf in Lynn Harbor. Approved November 12, 1873.

67. Salem Gas-Light Company, for leave to dredge and build a platform on piles on the sides of its wharf in Salem Harbor. Approved November 12, 1873.
68. John F. Dodge and others, for leave to build a wharf in Neponset River, Squantum. Approved November 12, 1873.
69. Bay State Iron Company, for leave to extend its wharves in South Boston. Approved December 10, 1873.
70. Boston Gas-Light Company, for leave to extend its wharf on Commercial Point. Approved November 19, 1873.
71. County Commissioners of Bristol County, for leave to construct a fender-pier in the bridge crossing Taunton River, between Berkley and Dighton. Approved November 19, 1873.
72. Pigeon Cove Granite Company, for leave to build a wharf in Johns River, Gloucester. Approved December 3, 1873.
73. Richard R. Walsh, for leave to drive piles in Roxbury Creek. Approved December 24, 1873.
74. Commissioners on West Boston and Cragie Bridge, for leave to rebuild and widen said bridge. Approved December 31, 1873.

This record shows an increase of duty performed over that of previous years.

During the session of the legislature the Board has been represented either by one or more of the Commissioners or by the engineer, at the hearings and meetings of the harbor committee, and has furnished such facts and data and made such examinations as were called for in connection with the various petitions and grants which were acted upon by the committee. Many of these cases required surveys or sketches of the grounds and structures under consideration.

This work has resulted in the accumulation of useful data in the archives of the Board, and in increased knowledge of the character and condition of the harbors and shores of the Commonwealth.

More attention than formerly seems to be given to coast improvements, both for commercial purposes and summer resorts.

In the harbors of Newburyport, Gloucester, Salem, Manchester, Boston, Plymouth, Duxbury, Wellfleet, Provincetown, Nantucket, Edgartown, Vineyard Haven, Wood's Hole, Wareham, and New Bedford, works of improvement have

been projected, begun or completed, either in the shape of new and increased railroad terminal facilities, new or extended wharves or to benefit navigation, showing that the water-frontage of the coast generally is increasing in value and importance.

JOSIAH QUINCY,
 DARWIN E. WARE,
 F. W. LINCOLN,
 J. N. MARSHALL,
 W. T. GRAMMER,

Board of Harbor Commissioners.

A P P E N D I X.

APPENDIX.

INDENTURE OF FOUR PARTS, BETWEEN THE COMMONWEALTH,
THE BOSTON AND ALBANY RAILROAD COMPANY, THE BOS-
TON WHARF COMPANY AND THE CITY OF BOSTON.

This Indenture, made this twenty-fourth day of June, eighteen hundred and seventy-three, by and between the Commonwealth of Massachusetts, acting by its Board of Harbor Commissioners, subject to the approval of the governor and council, of the first part, the Boston and Albany Railroad Company, a corporation established under the laws of said Commonwealth, of the second part, the Boston Wharf Company, a corporation also established under said laws, of the third part, and the City of Boston of the fourth part, Witnesseth :

That the said party of the first part, in consideration of the obligations of the party of the fourth part herein contained, hereby covenants and agrees with said party of the fourth part, that, before the first day of October, A. D. 1876, it will fill with solid filling, to the grade of sixteen feet above mean low water, the parcel of flats belonging to the said party of the first part, situated at the junction of the main channel and Fort Point Channel, in Boston Harbor, and bounded south-west by the flats of the Boston Wharf Company and south-east by the flats sold by the Commonwealth to the Boston and Albany Railroad Company, and described in the agreement between said Commonwealth and said Boston and Albany Railroad Company, dated December 8, A. D. 1869, and appended to the Fourth Annual Report of the Harbor Commissioners to the legislature, and in an agreement of even date with these presents modifying said agreement of said eighth of December, and will, before said first day of October, build a sea-wall around the margin of said parcel of flats upon said main and Fort Point channels ; excepting, however, from this covenant and agreement so much of said flats as shall be reserved for docks.

And the said party of the second part, in consideration of the ob-

ligations of the party of the fourth part herein contained, hereby covenants and agrees with the said party of the fourth part, that, before the said first day of October, A. D. 1876, it will fill with solid filling, to the grade of sixteen feet above mean low water, the flats described in said agreements, and sold by said Commonwealth to said Boston and Albany Railroad Company, and will, before said first day of October, build a sea-wall on the north-east side of said parcel of flats; excepting, however, from this covenant and agreement such portion of the said flats as shall be reserved for docks, and the space required for the natural slope of the filling on the south-east and south-west boundary lines of said flats.

And said party of the third part, in consideration of the obligations of said party of the fourth part herein contained, hereby covenants and agrees with said party of the fourth part, that it will, in eighteen months from the date of these presents, fill, to said grade sixteen, with solid filling, its flats lying north-east of Commissioners' line A, and south-east of the Commissioners' line on the south-east side of Fort Point Channel, as said party of the third part now is or shall hereafter be authorized to fill the same, and will, within the said eighteen months, build a sea-wall on the south-west side of said flats; excepting, however, from this covenant and agreement such portion of said flats as shall be reserved for docks.

And the said party of the fourth part, in consideration of the foregoing obligations of said parties of the first, second and third parts, hereby covenants and agrees with each of said parties of the first, second and third parts, its successors and assigns, that it will, after the walls and solid filling the said parties of the first and second parts have herein before agreed to build and to do, have been completed, and the flats to be filled by said party of the second part have been conveyed by said party of the first part to said party of the second part, and within twelve months after the request of the Board of Harbor Commissioners, approved by the governor and council, build a bridge for public travel over Fort Point Channel in extension of Northern Avenue, substantially as said avenue is located on the plan for the occupation of flats owned by the Commonwealth in Boston Harbor, annexed to the Sixth Annual Report of said Harbor Commissioners to the legislature.

And said party of the fourth part further covenants and agrees with each of said parties that it will, within eighteen months from the date of these presents, build a bridge for public travel across Fort Point Channel in extension of Eastern Avenue, and extend Eastern Avenue to some existing street on the north-westerly side of Fort Point Channel, substantially as said avenue is located on said plan annexed to said Sixth Annual Report of the Harbor Commis-

sioners, but at such a distance from the bridge of the Boston, Hartford and Erie Railroad that the draws in both bridges may be operated without interference with one another, and be convenient for the passage of vessels, or in such manner under section six of chapter three hundred and twenty-six of the Acts of the year eighteen hundred and sixty-eight, that the extension of said avenue may form a convenient connection with Congress Street. But said party of the fourth part shall not be obliged by this indenture to build said bridges and extend said avenue at a greater cost than the estimate of the city engineer, dated June 15, 1872, appended to the report of a joint special committee of the city council on the memorial of the Harbor Commissioners, asking the coöperation of the city in certain respects in the occupation of the South Boston Flats, and said party of the fourth part hereby agrees forthwith to locate said Eastern Avenue under the provisions of said sixth section of said three hundred and twenty-sixth chapter of the Acts of the year eighteen hundred and sixty-eight.

It is further agreed between said party of the first part and said party of the fourth part, that the style of the draws in said bridges, to be built by said party of the fourth part, and that the piling for said bridges and draws shall be determined by the board of aldermen of said city of Boston, and said Harbor Commissioners, provided that the width of the passage-ways for vessels shall not be less than thirty-six feet, and that the grade of said bridges shall be satisfactory to the surveyors of highways of said city.

And it is further agreed between said parties of the first and fourth parts that said party of the first part shall assume and pay into the compensation fund for Boston Harbor whatever shall be assessed under the fourth section of chapter one hundred and forty-nine of the Acts of the year 1866, as compensation for tide-water displaced by the said party of the fourth part in building said bridges and extending said avenues, except the amount, not exceeding thirty-five hundred dollars, which shall be assessed on account of the extension of said Eastern Avenue, which amount the said party of the third part hereby agrees with said party of the first part, to assume and pay into the treasury of the Commonwealth.

And said party of the fourth part, for the consideration aforesaid, hereby covenants and agrees with said party of the first part, that in case it shall fail to build said bridges and extend said avenues, or either of them, to some existing street on the north-westerly side of Fort Point Channel, the said party of the first part may build said bridges and extend said avenues for and on account of said party of the fourth part, and that it, the said party of the fourth part, will pay to said party of the first part all reasonable expenses, not

exceeding said estimate of the city engineer, which the party of the first part shall incur in building said bridges and extending said avenues as aforesaid, or either of them.

And said parties of the first, second and third parts hereby further covenant and agree, each for itself, with said party of the fourth part, that they will respectively fill to the grade of sixteen feet above mean low water, so much of their several parcels of land or flats between Fort Point Channel and the south-easterly line of said flats sold by the Commonwealth to the Boston and Albany Railroad Company as lie within the limits of said Northern and Eastern Avenues, as said avenues shall be defined and located under this indenture, and in addition that they will fill said avenues, on their respective parcels, in such a manner as to form a proper and convenient grade, satisfactory to the surveyors of highways for said city, with the extensions of said avenues, and the bridges which said party of the fourth part shall construct as herein provided, so soon as said extensions of said avenues and said bridges shall respectively be completed.

And said parties of the first, second and third parts further agree, each for itself, with said party of the fourth part, that said party of the fourth part may lay out as public streets, without incurring any liability for land damages for so doing, said Northern Avenue not more than one hundred feet wide, Eastern Avenue not more than seventy-five feet wide (the exact width of said avenues to be determined by the party of the first part unless determined by the said party of the fourth part within one year after said territory is filled), and the extension of B Street seventy-five feet wide on the north-easterly side of Eastern Avenue, over the said respective parcels of the said parties of the first, second and third parts lying between Fort Point Channel and the south-easterly boundary line of said flats sold by the Commonwealth to said Boston and Albany Railroad Company, as said avenues and the extension of B Street are shown on said plan of occupation, or as the same shall be located under this indenture.

And said parties of the first, second and third parts further agree, that when said avenues and said extension of B Street within said limits shall have been filled and laid out as herein provided, they will each convey to said party of the fourth part the fee of their said respective parcels within the limits of said avenues, and said extension of B Street; but said party of the second part hereby reserves the right in its said parcel, and in such conveyance may reserve the right to lay its tracks at grade across Eastern Avenue, the extension of B Street north-easterly of Eastern Avenue, and across Northern Avenue, and to lay its tracks, not exceeding two,

at grade along said Northern Avenue and the said extension of B Street north-easterly of Eastern Avenue, as authorized by the fourth section of chapter four hundred and sixty-one of the Acts of the year eighteen hundred and sixty-nine; the location of said tracks along said extension of B Street and Northern Avenue to be determined by said party of the second part, with the assent and approval of the surveyors of highways of said city of Boston.

And said parties of the first, second and third parts further agree, each for itself, with said party of the fourth part, that said party of the fourth part may build main sewers, and such other sewers as the board of health of the city of Boston may deem necessary for the proper drainage of the territory to be filled by said parties of the first, second and third parts, as herein described, and any territory abutting thereon or connected therewith, and may use any street, passage-way or dock for the purpose of such sewers or drains, and discharge the contents thereof in said docks or in front of said sea-walls, as the board of health of said city may direct; and said party of the fourth part may assess a just and equitable portion of the expense thereof upon the lots in said territory to be filled by said parties of the first, second and third parts which shall be benefited thereby; said assessment to be laid according to the rules established for the city sewers, and according to the laws of the Commonwealth relating thereto at the time such drains shall be built; the amount of such assessments to be paid by the owners of such lots when the same shall be filled up as aforesaid and require drains, and in no case before.

And said party of the first part further covenants and agrees with said party of the fourth part, that as the other territory of the South Boston flats belonging to said party of the first part, within the limits of the first section of said South Boston flats, as shown on said plan of occupation appended to said Sixth Annual Report, including the extension of L Street, shall be filled to grade, the said party of the first part will provide that Northern Avenue and Eastern Avenue, as shown on said plan, or as the same may be located under this indenture, the extensions of C, D, E, F, and K streets to Eastern Avenue, the extension of L Street as shown on said plan, and the extension of B Street below the hundred-rod line, as shown on said plan, shall, so far as such avenues and extensions are within the said territory, and as fast as the portions of the territory bordering on said avenues and extensions are filled, also be filled to the grade of sixteen feet above mean low water; and further, that said party of the fourth part may within the said territory lay out the same when filled as public streets, without incurring any land damages for so doing, and that when so laid out as public

streets, said party of the fourth part shall have a conveyance of the said territory within the limits of said avenues and the said extension of streets.

And the said party of the first part, for the considerations aforesaid, further covenants and agrees with said party of the fourth part, that within one year after the filling to be done by the parties of the first, second and third parts has been completed as herein provided, it, the said party of the first part, will build so as to connect with Eastern Avenue, the extension from First Street, of B Street or C Street, as the Harbor Commissioners may elect, and that whichever of said streets said Commissioners may elect to build shall be filled in such a manner as to form a proper and convenient grade satisfactory to the surveyors of highways of said city of Boston; and in case said Commissioners shall elect to build C Street, that said party of the first part will build Eastern Avenue as herein before provided, out to the extension of said C Street, the said party of the fourth part hereby authorizing said party of the first part to build said extension of B and C streets as herein provided.

And the said parties of the first and third parts further agree, each for itself, with said party of the fourth part, that said party of the fourth part may, within one year, lay out an avenue in extension of Mount Washington Avenue south-eastwardly from Granite Street over any flats of said parties now filled, and over any other portions of the flats of said parties within the limits of such extension, within one year after such portion is filled to grade sixteen, without incurring any liability for land or grade damages for so doing; and that when so laid out they will respectively convey to said party of the fourth part, said territory within the limits of the said avenue where the same is extended over their lands.

And said parties of the first, second and third parts, for the considerations aforesaid, hereby each for itself covenants and agrees with said party of the fourth part, that the party of the fourth part shall be subjected to no grade or other damages for any land taken of either of said parties, or any injury done to land of either of said parties, on the south-east side of Fort Point Channel, in performing its obligations under this indenture.

And said party of the third part, in consideration of the obligations of said party of the first part herein contained, hereby covenants and agrees with said party of the first part, that it will fill its territory, herein before described, as fast as the said party of the first part shall fill its territory on the division line of their respective parcels, so that it will not be necessary to have a bulkhead or

barrier on such division line to retain the filling of said party of the first part, and that if said party of the third part shall not fill its said territory as fast as said party of the first part fills its territory on such line, so that a barrier or bulkhead as aforesaid becomes necessary, said party of the first part may build, at the expense of said party of the third part, such a bulkhead or barrier along such division line as may be necessary to retain the filling as aforesaid; and whenever said party of the first part shall begin at said division line to build the sea-wall which it has herein before agreed to build, the said party of the third part hereby agrees to begin at said line to build the sea-wall which it has herein agreed to build, and that it will prosecute the building of the same with vigor to its completion; that it will, within eighteen months from the date of these presents, fill to grade sixteen its said territory, and will, after said Eastern Avenue has been located, and the building of the bridge therefor commenced, dredge the flats lying in the section of Fort Point Channel opposite its said territory uniformly to the thread of said channel, to the depth of twelve feet at mean low water; and in case said party of the third part shall fail to begin or to prosecute the construction of said sea wall, or to fill its said territory as herein provided, the said company hereby agrees that said Commonwealth may enter upon said territory, and build so much of said sea-wall, and do so much of said filling, as it shall see fit, at the expense of said party of the third part; and said party of the third part hereby agrees to pay to said party of the first part all the reasonable expenses it shall incur in building said sea-wall, and in filling as aforesaid, on the territory of said party of the third part.

And said party of the third part hereby further covenants and agrees with said party of the first part, that the said party of the first part and its assigns shall have, at convenient places to be designated by said party of the third part, a right of way from the track of the New York and New England Railroad across the territory of said party of the third part, for the purpose of filling said adjoining territory of said party of the first part; and that said party of the first part shall have the right to lay railroad tracks on the same, for the transportation in cars of material to be used in the work of filling said territory of the party of the first part; but such right of way shall not continue after the first day of October, A. D. 1876. If said party of the third part shall not have filled its territory to grade sixteen before the first day of August, A. D. 1875, so as to furnish a convenient right of way to the said territory of the party of the first part, the said party of the first part shall have the

right to enter upon said territory of said party of the third part, and fill, at the expense of said party of the third part, so much of the same as may be required to furnish a convenient right of way to said territory of the party of the first part, for the purpose of transporting material as aforesaid to, and filling with such material, said territory; and said party of the third part hereby agrees to pay to said party of the first part all the reasonable expenses it shall incur in so filling such portion of the territory of said party of the third part.

And said party of the third part hereby further covenants and agrees that, together with said party of the second part, if it shall hereafter so agree, or otherwise, it will lay out a street for public use in some convenient location, to be determined by said party of the third part, not less than fifty feet in width, extending from Eastern Avenue north-easterly to the north-easterly line of the territory of said party of the third part, within one year from the completion of the filling of the territory of said party of the first part, as herein before agreed by said party of the first part; provided, that said party of the third part shall not before said time have sold, for railroad purposes, its territory north-east of said Eastern Avenue, or such part thereof as to make it inconvenient for the railroad using said territory that said street should be laid out; and provided, also, that said party of the fourth part shall lay out and extend said Eastern Avenue, or take land for said purpose, or take some other decisive action to extend said avenue, as herein before agreed by said party of the fourth part, within six months from the date of these presents.

In testimony whereof, on the day and year first above written, the said Commonwealth has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and delivered in its name and behalf, by Josiah Quincy, Darwin E. Ware, Frederic W. Lincoln, Joshua N. Marshall, and William T. Grammer, its Harbor Commissioners, and the same to be approved by its governor and executive council; and the said Boston and Albany Railroad Company has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and delivered, in its name and behalf, by Chester W. Chapin, its president, thereunto duly authorized; and the said Boston Wharf Company has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and delivered, in its name and behalf, by Jacob Sleeper, its president, thereunto duly authorized; and the said city of Boston has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and deliv-

ered, in its name and behalf, by Henry L. Pierce, its mayor, thereunto duly authorized by said city.

Signed, sealed and delivered in presence of

HENRY L. WHITING.

[SEAL.]

COMMONWEALTH OF MASSACHUSETTS,

By JOSIAH QUINCY,

DARWIN E. WARE,

F. W. LINCOLN,

J. N. MARSHALL,

W. T. GRAMMER,

Harbor Commissioners.

BOSTON AND ALBANY RAILROAD CO.,

By C. W. CHAPIN, *President.* [SEAL.]

BOSTON WHARF CO.,

By JACOB SLEEPER, *President.* [SEAL.]

CITY OF BOSTON,

By HENRY L. PIERCE, *Mayor.* [SEAL.]

COMMONWEALTH OF MASSACHUSETTS.

IN COUNCIL, July 15, 1873.

Approved :

OLIVER WARNER, *Secretary.*

AGREEMENT BETWEEN THE COMMONWEALTH AND THE BOSTON AND ALBANY RAILROAD COMPANY.

WHEREAS, by articles of agreement, dated December 8th, A. D. 1869, made by and between the Commonwealth of Massachusetts, acting by its Board of Harbor Commissioners with the approval of the governor and council, and the Boston and Albany Railroad Company, a corporation organized under the laws of said Commonwealth, said Commonwealth agreed to sell, and said Company agreed to buy, a parcel of flats in Boston Harbor, upon certain terms set forth in said agreement, and said Company therein agreed to improve said flats by building a sea-wall upon them, and fill them according to the terms of said agreement; and whereas delays have occurred in the improvement of the flats lying north-westerly of those sold to said Company not anticipated when said agreement was made between said Company and the Commonwealth, which have tended to delay the improvement by said Company of the flats so purchased by it; and whereas, in arranging with the city of Boston the terms on which said Company might use its territory so purchased for railroad purposes, consistently with the maintenance in the same locality of highways safe and convenient for travel, it

has been found convenient that said Company should surrender to the Commonwealth so much of the flats purchased of the Commonwealth as lie south-west of the south-westerly line of Eastern Avenue as it shall be located over said territory, and should take of the Commonwealth, in place of the area surrendered, other flats; and whereas other modifications of said agreement have become expedient; NOW, THEREFORE, the said Commonwealth, acting by its Board of Harbor Commissioners, subject to the approval of the governor and council, in consideration of the agreements herein contained of said Company, and the execution by said Company of an indenture of four parts, of even date with these presents, between said Commonwealth, said Boston and Albany Railroad Company, the Boston Wharf Company, and the city of Boston, hereby agrees to extend, and does extend, the time of the payment of the purchase-money stipulated in said agreement of said December 8th, and the time for doing such work in relation to said territory as was required by said agreement to be done by the first day of October, A. D. 1875, to the first day of October, A. D. 1876, and said Commonwealth hereby releases the said Company from all claim for interest on said purchase-money heretofore accrued, and agrees that no interest shall accrue on said purchase-money for any period prior to said last-mentioned date.

Said Commonwealth and said Company hereby release each the other from all its obligations in said agreement contained, in relation to so much of the parcel of flats described in said agreement as lies south-west of the south-westerly line of Eastern Avenue, as the same shall be laid out under the said indenture of four parts, and said Company hereby surrenders to said Commonwealth such portion of said flats described in said agreement of said 8th of December, free and discharged from the operation of the same, except such portion of said flats as is to be conveyed to said Company, as hereinafter provided, for a road-bed for its tracks; and in place of, and as an equivalent for, such flats so surrendered, the said Commonwealth hereby agrees with said Company to convey to it of the area of flats belonging to the Commonwealth situated at the junction of Main and Fort Point Channels, bounded south-westerly by the flats of the Boston Wharf Company, and south-easterly by the said flats sold to said Boston and Albany Railroad Company, a strip along the south-easterly margin of said flats of the Commonwealth, bounded south-easterly by said flats sold to said railroad Company under said agreement of said 8th of December, and included by parallel lines extending from said flats of said Boston Wharf Company, to the exterior line defined in said agreement, so drawn as to include an area amounting to two-fifths of the area

herein surrendered by said Boston and Albany Railroad Company, from its purchase under said agreement.

And said Commonwealth and said Boston and Albany Railroad Company hereby mutually agree, each with the other, that the provisions of said agreement of said 8th of December, as modified by these presents, shall apply to said strip of flats to be conveyed to said Company in place of, and as an equivalent for, the said flats herein surrendered to said Commonwealth, to the same extent in all respects, except as herein provided, as though such strip were included within the original tract of flats to which said agreement relates; and they further agree to define specifically, by metes and bounds, said strip, as soon as Eastern Avenue shall be located under said indenture of four parts.

And said Commonwealth hereby further agrees with said Company, that it will convey to said Company in fee, at the rate of twenty cents for every square foot, such an area of the territory described in said agreement of said 8th of December, lying south-west of Eastern Avenue, as located under said indenture of four parts, and north-west of the extension of B Street, not exceeding forty feet in width, as said Company shall take for a road-bed for its tracks; and said Company hereby agrees with said Commonwealth, that it will fill such area, so taken for a road-bed, in accordance with the obligations of said Company for filling the area to be conveyed to it lying north-east of Eastern Avenue, and that it will locate its said road-bed for tracks south-west of Eastern Avenue, over the territory of the Commonwealth, on or before the said first day of October, 1876;

Provided, however, that should Eastern Avenue be located over the territory described in said agreement of said 8th of December farther north than it is located according to the plan for the occupation of flats owned by the Commonwealth in Boston Harbor appended to the Sixth Annual Report of the Board of Harbor Commissioners, said Company shall, if required by said Board, take the additional area of such territory brought south of Eastern Avenue by the change from the location shown on said plan, in a strip of the same area, of equal width, along the south-easterly line of its territory, as limited by such new location; or, at the option of said Boston and Albany Railroad Company, said Company shall be entitled to have deducted from the purchase-money said Company is to pay said Commonwealth, the value of such additional area that shall be brought south of Eastern Avenue by such change of location, and in consequence surrendered from the amount purchased by said Company, reckoning such value at twenty cents per square foot.

And said Commonwealth hereby further agrees with said Boston and Albany Railroad Company, that in case said Company shall reserve a portion of its said flats at the south-easterly corner of the same for a dock, and build the wall for such dock on the north-westerly and south-westerly sides of such portion so reserved, then said Company shall be exempt from the obligation to fill on the south-easterly boundary line of such area, for the protection of filling in the adjoining territory, as provided in said agreement of said 8th of December.

And said Commonwealth hereby further agrees with said Company, that in making the determination of the amount to be added to, or deducted from, the purchase-money, after the survey provided in said agreement of the 8th of December, there shall be deducted from the amount of such purchase-money, the cost of the wall built by said Company along the north-easterly border of said westerly strip to be conveyed as herein provided to said Company, determining said cost at the average rate of the contract price said Company shall pay for the wall to be built by it along the north-easterly margin of its whole tract purchased under said agreement and these presents; and that there shall further be deducted from such purchase-money one-half the cost of the filling of Eastern Avenue, on the territory of said Company, estimating such cost at the average contract price said Company shall pay for the filling of its said territory purchased of said Commonwealth.

And said Commonwealth hereby further agrees with said Boston and Albany Railroad Company, that in case Northern Avenue, Eastern Avenue, or the extension of B Street within the limits of the territory to be conveyed to said Company, shall be laid out under said indenture of four parts, to a greater width than is stipulated in said agreement of said 8th of December, said Company shall not be liable to pay, under said agreement, for the additional area appropriated to such streets by such increase of their width.

And said Commonwealth hereby further agrees, for the purpose of avoiding the necessity of building bulkheads on the north-westerly division line of the territory of said Company, to retain the filling when done by said Company on such line, that it and its assigns will fill upon said north-westerly division line between the territory to be conveyed to said Company and the territory of the Commonwealth adjacent, simultaneously with the progress of filling on said line by said Company, upon twenty days' notice in writing of the intention of said Company so to fill on such line; provided that said Commonwealth nor said Company shall be required so to fill, until the sea-wall on the north-westerly and north-easterly borders of the territory of the Commonwealth is so far built as to fur-

nish a protection to the filling on such division line from the currents of the channels of Boston Harbor.

And said Commonwealth and said Boston and Albany Railroad Company bind themselves, each to the other, to the faithful performance of their respective agreements herein before set forth, and of their respective obligations under said agreement dated December 8th, A. D. 1869, as herein modified firmly by these presents.

In testimony whereof, the said Commonwealth has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and delivered, in its name and behalf, by Josiah Quincy, Frederic W. Lincoln, Joshua N. Marshall and William T. Grammer, its Harbor Commissioners; and the same to be approved by its Governor and Executive Council; and the said Boston and Albany Railroad Company has caused its corporate seal to be hereto affixed, and these presents to be signed, acknowledged and delivered, in its name and behalf, by Chester W. Chapin, its president, thereunto duly authorized by the vote of the directors of said Company, a copy of which is hereto annexed, this twenty-fourth day of June, A. D. eighteen hundred and seventy-three.

COMMONWEALTH OF MASSACHUSETTS, [SEAL.]

By JOSIAH QUINCY.

F. W. LINCOLN.

W. T. GRAMMER.

J. N. MARSHALL.

Signed, sealed and delivered in presence of

HENRY L. WHITING.

BOSTON & ALBANY RAILROAD COMPANY, [SEAL.]

By C. W. CHAPIN, *President*.

In presence of ERASTUS HAYES.

COMMONWEALTH OF MASSACHUSETTS.

IN COUNCIL, July 15, 1873.

Approved:

OLIVER WARNER, *Secretary*.

AGREEMENT BETWEEN THE COMMONWEALTH AND MESSRS. CLAPP AND BALLOU AND THE ROCKPORT GRANITE COMPANY OF MASSACHUSETTS.

ARTICLES OF AGREEMENT

Made this twenty-ninth day of September, in the year eighteen hundred and seventy-three, by and between the Rockport Granite Company of Massachusetts, a corporation established under the laws of the Commonwealth of Massachusetts, George Clapp and Frederick R. Ballou, both of Boston, in the county of Suffolk and

said Commonwealth, partners under the firm and style of Clapp & Ballou, the said Rockport Granite Company and Clapp & Ballou being parties of the first part, and the Commonwealth of Massachusetts, acting by its Board of Harbor Commissioners, party of the second part, *Witness*:

The said parties of the first part hereby covenant and agree with said party of the second part, to build two sea-walls, one a light sea-wall, the other a heavy sea-wall, on a parcel of land and flats belonging to the party of the second part, situated in Boston Harbor, and bounded south-westerly by land and flats of the Boston Wharf Company, north-westerly by Fort Point Channel, north-easterly by the main channel, and south-easterly by land and flats sold by said party of the second part to the Boston and Albany Railroad Company, the north-westerly boundary line of which is to be hereafter defined, and to fill said parcel with solid material to the grade of sixteen feet above mean low water, in the manner and upon the terms and conditions following:

First. The base of said light sea-wall shall commence at a point marked X, on annexed plan marked C, twenty-five feet easterly of the Commissioners' line, on the easterly side of Fort Point Channel, established by chapter 35 of the Acts of the year 1840; and thence extending, as shown by the red line on annexed plan marked C, parallel to said Commissioners' line of 1840, and the modified line of 1867, to a point three hundred and eighty-seven and a half feet northerly from Commissioners' line B, said point to be subject to alteration by the engineer of the Board of Harbor Commissioners.

Said wall shall be built in accordance with the plan marked D, hereto annexed, and in such location as shall be marked out by the engineer of the Board of Harbor Commissioners previous to the commencement of operations by the parties of the first part; and the parties of the first part shall preserve the location of said line by driving piles to mark the location of the wall permanently.

The trench shall be dredged for the wall, under the direction of said engineer, to a depth of two feet below low-water spring-tides.

The foundation piles to support the wall shall occupy a space nine feet wide, having five piles in parallel rows, said rows to be two and one-half feet distant from centre to centre of each row.

All piles shall be driven into the hard clay stratum to the satisfaction of the engineer of the Harbor Commissioners. The piles to be in diameter not less than ten inches at low-water mark spring-tides, at which point they are to be sawed off level with each other.

On the top of the piles are to be spiked two layers of spruce plank, twelve inches wide and three inches thick, lying at right

angles with each other. The space between the heads of the piles, for two feet in depth, to be filled and well rammed with stone-chip ballast or oyster-shells.

The wall, from low water of spring-tides to the top of the coping-stones, or grade sixteen, shall be eighteen feet in height, with a true batter front and rear. The wall shall be nine feet wide at the bottom, and five feet wide at the top, including an offset of one foot for a resting-place for cap to support the ends of platform-joists; to be constructed of good quality granite rubble-wall stones, from eighteen inches to two feet thick, with sufficient headers to secure the stability of the wall, well bonded and pinned throughout.

The rear of the wall shall be ballasted with oyster-shells, from the back of the wall to a line commencing at a point two feet in rear of the back of the top of the wall, and extending in a slope of forty-five degrees to the base of the wall, as shown on said annexed plan marked D.

At the end of the wall a flank wall shall be built, to connect this wall with the adjoining heavy sea-wall, according to the direction of the engineer of the Board of Harbor Commissioners.

This wall to be commenced within thirty days after notice that the location of the wall is made, and the work to be prosecuted without delay to its completion, and completed on or before the first day of May, eighteen hundred and seventy-four.

Second. The base of the heavy sea-wall shall be built on a line parallel to said modified line of 1867, and one foot within the same, as aforesaid, as shown by red line on said plan C, and in such location as shall be marked out by the engineer of the Board of Harbor Commissioners previous to the commencement of operations by the parties of the first part; and the parties of the first part shall preserve the location of said line by driving piles to mark the location of the wall permanently. This sea-wall shall be built in accordance with the plan marked G hereto annexed. The trench for this sea-wall shall be excavated to the satisfaction of said engineer, forty-five feet in width at the bottom, which shall be as nearly as practicable a level surface. The depth of the trench shall be at least twenty-three feet below mean low water, and always to hard bottom.

This trench is to be filled with broken quarry-stones of mixed sizes, none less than seventy-five pounds' weight, thrown in and deposited in regular layers of not over four feet each in depth, and each layer is to be placed compactly by divers with bars before depositing the next layer.

This filling is to be forty-five feet in width at the bottom and for the lower three feet of its depth, thence sloping inward on each side with a slope of one and a half horizontal to one vertical for a

further depth of nine feet, where at a level of eleven feet below mean low water it is to be eighteen feet in width. The filling is to be levelled up here with smaller chips of quarry-stone to receive the wall, and the outer or harbor slope is to have the interstices well filled with similar chips.

The wall to the height of one foot below low water shall be built in quarry-face dimension-stone of granite, laid in courses of two feet rise each, by the aid of submarine divers. The courses shall be laid alternately, entirely with headers and stretchers, the bottom or first course being headers. Each stone shall be at least four feet, and not more than ten feet long, at least eighteen inches wide, and exactly two feet rise, fitted to one-inch joints, square ends, and out of wind.

The wall shall be compactly laid in a substantial and workmanlike manner, with fair and close outer face. Stones shall be laid so as to break joints everywhere, with good and sufficient bearing upon the beds without pinnars.

The base of the wall shall be fourteen feet. The height of the wall, to one foot below mean low water, ten feet, and the thickness of the wall, at top, eleven feet four inches.

The wall, from one foot below mean low water to the top of the coping-stones, or grade sixteen, shall be laid with dimension-stone in cement. The courses shall be laid with headers and stretchers, with not over ten feet interval between the headers, and have two feet rise, with the exception of the coping course, which shall have a rise of three feet, and be entirely of headers. The stretchers shall be at least four feet long, and the headers shall not be less than six feet long from face inwardly. The batter of each face shall be two inches to the foot. The base of this wall shall be nine feet eight inches, the height seventeen feet, and the thickness at the top of the wall five feet.

The back of the whole of the heavy wall, from top to bottom, shall be ballasted with clean gravel, cobbles or oyster-shells, resting at a slope as steep as they will stand, or forty-five degrees, and tapering to nothing at the top of the wall.

This heavy sea-wall shall be commenced by the first day of May, 1874, and finished by the first day of August, 1875.

Third. Spaces in said walls for docks, or for the purpose of filling by scows, or any other purpose, may at any time be reserved permanently or temporarily by said Board of Harbor Commissioners, upon notice before the structure of the wall is begun in any such space; and where such space is permanently reserved, it shall be filled by a strong bulkhead, to the satisfaction of the said engineer.

Fourth. The filling on said parcel of land and flats must be up to

grade sixteen. Up to grade thirteen the filling must be with materials dredged from the mouth of Fort Point Channel, below the line of Oliver Street extended, and from that part of Boston Harbor represented by the space colored red on the "Plan for the occupation of flats owned by the Commonwealth in Boston Harbor," appended to the Sixth Annual Report of the Board of Harbor Commissioners, and other portions of Boston Harbor above a line extended from Buoy No. 11 at right angles with the line of said heavy sea-wall on the main channel. All such portions of Boston Harbor are to be dredged to a uniform depth of twenty-three feet at mean low water. Such portion of Fort Point Channel is to be so dredged that the bottom shall uniformly and gradually slope from a depth of twelve feet at mean low water at the line of Oliver Street to a depth of twenty-three feet at the south-west border of the area represented by the space colored red on said plan. The residue of the filling to grade sixteen must be with good clean gravel.

All material obtained from the dredging required by this agreement may be used as filling, except above grade thirteen. The whole filling to be finished on or before October 1st, 1876. Where the said sea-walls to be built around said flats shall not be built so as to furnish the requisite protection to the filling, temporary bulkheads must be built for that purpose, as required by the Board of Harbor Commissioners. Spaces required for docks may be reserved at any time from filling by the Board of Harbor Commissioners.

Fifth. Both the dredging and the filling shall be done according to the direction of the Board of Harbor Commissioners.

And said parties of the first part further covenant and agree with said party of the second part to give the Board of Harbor Commissioners and its agents every facility that may be required by said Board for the inspection of materials to be used and of the work done by said parties under this agreement and while such work is in progress; and also agree, if at any time during the progress of the work, any work shall be done or any material used which shall be considered by the engineer of said Board unfit and inferior according to the true intent of this agreement, that, upon receiving notice thereof, they will forthwith remove such objectionable work or material and substitute other in its place which shall be satisfactory to such engineer.

The said party of the second part hereby covenants and agrees with said parties of the first part to pay said parties for building said sea-walls and filling said land and flats in the manner and upon the terms and conditions herein set forth and agreed as follows:—

For the light sea-wall, at the rate of thirty-nine dollars for every lineal foot of finished wall.

For the heavy sea-wall, at the rate of two hundred and thirty-six dollars for every lineal foot of finished wall.

For the filling up of said parcel of land and flats with dredged material and good clean gravel, as herein agreed, at the rate of thirty-nine cents for every superficial foot of said territory so filled according to the measurement of the same by the engineer of the Board of Harbor Commissioners on the completion of the whole contract. In determining the whole amount to be paid for the filling by measuring on the surface inside the top of the sea-walls, a deduction shall be made at the rate of fifty-nine cents per cubic yard for the number of cubic yards of ballast, foundation and other material constituting the walls, that would otherwise, by a superficial measurement of the filling, be reckoned as a part of such filling.

Payments will be made every month for the work performed under this contract to the satisfaction of the engineer of the Board, at the rate of ninety per cent. of the contract price of the work done during the month as reported and certified to by the said engineer, and upon the approval of the bills by the Board of Harbor Commissioners and the governor and council. Such payments may be made to and receipted for by some party authorized to receipt for the same by an instrument in writing duly executed by said parties of the first part.

And said party of the second part further agrees that said parties of the first part, in performing the work herein contracted for, may have the benefit of and exercise the rights secured to said party of the second part and its assigns by certain provisions of an indenture of four parts, dated the twenty-fourth day of June, A. D. 1873, made by and between said party of the second part, the Boston and Albany Railroad Company, the Boston Wharf Company and the city of Boston, whereby said Boston Wharf Company made certain covenants and agreements with said party of the second part in relation to filling on the division line between said land and flats of the Boston Wharf Company and the lands and flats of said party of the second part, and in relation to the building of bulkheads or barriers on said line to retain the filling, and in relation to a right of way secured to said party of the second part and its assigns, from the track of the New York and New England Railroad to the territory to be filled under this agreement, and in relation to the right to lay railroad tracks over the territory of said Boston Wharf Company for the transportation in cars of material to be used in filling said territory of said party of the second part. It is, however,

understood and agreed by and between the parties hereto, that whatever the parties of the first part may do in the exercise of said rights secured as aforesaid to the party of the second part and its assigns, the said parties of the first part shall do at their own proper cost and expense, and that said party of the second part shall be in no respect responsible for them or their action or any liabilities whatever which they may incur.

It is further agreed by and between the parties hereto, that whenever the appropriations of the legislature now or hereafter made for the work herein contracted for shall become exhausted before the work is completed, then no more work shall be done, and neither of said parties shall be under any obligation to proceed further under this agreement; but so long as there shall be appropriations of the legislature from which the work as it is done can be paid for from month to month as herein provided, this agreement shall be in full force and virtue.

It is further agreed by and between said parties hereto, that any person shall be deemed the engineer of the Board of Harbor Commissioners within the meaning of this agreement, whom said Board shall at any time, or from time to time designate, for the performance of any service it may desire in relation to the work to be done under this agreement.

It is further agreed by and between said parties hereto, that the Harbor Commissioners, subject to the approval of the governor and council, shall have the right to make changes in the plan of doing said work, should occasion arise, and make such additions to and reductions from the contract price as shall be just to both parties.

It is further agreed by and between said parties hereto, that should the parties of the first part refuse or neglect to execute according to this agreement the work herein contracted for, or fail to prosecute with the requisite vigor to insure its completion within the time agreed upon, or in any other respect violate this agreement, the Board of Harbor Commissioners shall have the power to annul this agreement and to contract anew with other parties.

It is further agreed by and between said parties hereto, that in case any difference shall arise under this agreement between the parties of the first part and the party of the second part, acting by the Board of Harbor Commissioners, that the said parties of the first part and said Board are unable to settle and adjust, the same shall be finally determined upon hearing by the governor and council.

In testimony whereof, the Rockport Granite Company aforesaid has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by John Stimson,

its treasurer ; and the said George Clapp and Frederick K. Ballou have hereunto set their hands and seals, and the said Commonwealth has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by Josiah Quincy, Darwin E. Ware, Frederic W. Lincoln, Joshua N. Marshall and William T. Grammer, its Harbor Commissioners, and the same to be approved by its governor and executive council the day and year first above written.

Signed, sealed and delivered in the presence of

E. C. PERKINS.

ROCKPORT GRANITE COMPANY OF MASSACHUSETTS,

By JOHN STIMSON, *Treasurer*. [Seal.]

GEORGE CLAPP. [Seal.]

F. K. BALLOU. [Seal.]

COMMONWEALTH OF MASSACHUSETTS, [Seal.]

HENRY MITCHELL.

By JOSIAH QUINCY.

DARWIN E. WARE.

F. W. LINCOLN.

J. N. MARSHALL.

W. T. GRAMMER.

IN COUNCIL, October 10, 1873.

Approved : OLIVER WARNER, *Secretary of the Commonwealth*.

BOND.

Know all men by these Presents, That we, the Rockport Granite Company of Massachusetts, a corporation established under the laws of the Commonwealth of Massachusetts, George Clapp and Frederick K. Ballou, both of Boston, in the county of Suffolk, and said Commonwealth, partners under the firm and style of Clapp & Ballou, as principals, and Aaron W. Russell and Jesse Buntin, both of Quincy, in the county of Norfolk and said Commonwealth, Asa C. Sanborn, of Cambridge, in the county of Middlesex in said Commonwealth, John Stimson and John H. Stimson, both of said Boston, as sureties, are holden and stand firmly bound unto the Commonwealth of Massachusetts in the sum of two hundred and fifty

thousand dollars, to the payment of which to the said Commonwealth of Massachusetts we hereby jointly and severally bind ourselves, our successors, heirs, executors and administrators.

The condition of this obligation is such that if the above-bounden Rockport Granite Company, Clapp and Ballou shall faithfully, well and truly perform their obligations under the foregoing agreement, made by and between them and the said Commonwealth of even date with these presents, and shall do or cause to be done according to the requirements of said agreement, in the manner and upon the terms and conditions therein set forth, all the work in said agreement contracted for, then this obligation shall be void; otherwise, remain in full force and virtue.

In witness whereof the said Rockport Granite Company has caused its corporate seal to be hereto affixed and these presents to be signed and delivered by John Stimson, its Treasurer, thereunto duly authorized; and we, the said George Clapp and Frederick K. Ballou, Aaron W. Russell, Jesse Buntin, Asa C. Sanborn, John Stimson and John H. Stimson, have hereunto set our hands and seals this twenty-ninth day of September, A. D. eighteen hundred and seventy-three.

Signed, sealed and delivered in the presence of
E. C. PERKINS.

ROCKPORT GRANITE COMPANY OF MASSACHUSETTS.

JOHN STIMSON, <i>Treasurer</i> .	[Seal.]
GEORGE CLAPP.	[Seal.]
F. K. BALLOU.	[Seal.]
A. C. SANBORN.	[Seal.]
JOHN STIMSON.	[Seal.]
JESSE BUNTIN.	[Seal.]
JOHN H. STIMSON.	[Seal.]
A. W. RUSSELL.	[Seal.]

IN COUNCIL, October 10, 1873.

Approved:

OLIVER WARNER, *Secretary of the Commonwealth*.

REPORT OF PROFESSOR MITCHELL.

ADDITIONAL PARTICULARS CONCERNING THE CHANGES IN THE
NEIGHBORHOOD OF CHATHAM AND MONOMOY.

A year ago I had the honor to present a somewhat lengthy report concerning the coast of Chatham and the Peninsula of Monomoy; since which time a few additional items of information have been collected which deserve, perhaps, to be recorded.

In my previous report, I made some translations from Champlain's notes, made during a voyage along our coast in 1606, in which he speaks of *Malle Barre* (Nauset Inlet, of which he not only gives a special map on large scale, but distinctly marks the location upon his coast chart of "*Nouvelle Franse*"), and of his coasting thence along an "arenaceous" shore and onward round a dangerous "*point of sand which juts out three leagues to the S. S. E.—a very dangerous place,*" which he calls "*Cap Batturier,*" and which we call Monomoy; and finally of his arrival at "*Port Fortuné,*" of which he gives a large scale map, which we easily recognize as Chatham. I alluded to the popular tradition that Monomoy is a very recent creation of the sea, and cited maps and reports to show the connecting links of evidence between the Monomoy of to-day and the "*Cap Batturier*" of Champlain. It is true that if Monomoy had been, from the outset, increasing as rapidly as it has been since our first regular coast survey sheet of 1847, we might argue that in 1606 no decided peninsula existed. Still, in the face of its representations upon Champlain's map of "*Nouvelle Franse,*" and upon the chart of the British Coast Pilot of 1707, and in spite of its length being stated in the "*Description of Barnstable*" of 1802, I did not think I could give any considerable weight to *traditions*—even though my excellent friend, Mr. Otis, of Yarmouth, had taken never so much care in collecting them. The fact that I was stating was simply the rapid gain of Monomoy upon the waters of Nantucket Sound, and I looked back into the history of this to ascertain whether there was any probability that this strip of beach would cross the channel lying between its extremity and the neighboring shoals, or even annex Nantucket to the main land. I was satisfied that its progress had been intermittent, and that the gain had been at a higher rate recently than formerly; and I think any one who will go back over the charts, as I have done, selecting as authority

only those which are professional in character, will come to the same conclusion.

The following table gives the distances from James' Head (site of present Chatham Light-houses) to the extreme point of Monomoy :—

YEAR.	AUTHORITY.	Distance in Statute Miles.	REMARKS.
1606	Champlain's estimate: "3 leagues" common? 3 " maritime?	8.28 10.36	{ The <i>common league</i> of France in the 17th century, was 25 to the degree—the maritime, 20.
1707	English Coast Pilot: Sailing Directions, Chart,	7.75 10.00	{ The bearing of Monomoy Point from the Tail of the Horseshoe is given in the Sailing Directions. Upon the accompanying chart Monomoy is represented as an island 10 miles long and 3 miles wide at broadest place.
1781	Des Barres' large scale map,	8.50	{ On this chart, for the first time, Monomoy is properly oriented, and takes the form which we see on recent charts (essentially). See "Atlantic Neptune."
1802	"Description of Barnstable," Mass. Hist. Col.,	7.75	
1853	U. S Coast Survey, . .	8.00	{ Plane table sheet of S. A. Gilbert.
1856	" " "	8.08	{ Plane table sheet of P. C. F. West.
1868	" " "	8.36	{ Plane table sheet of C. H. Boyd.

NOTE.—The estimate of Champlain will be increased if we suppose that he counted from Morris Island instead of James' Head. Upon his general coast map of "*Nouvelle France*," Monomoy is represented in a manner that makes it doubtful whether he designed to make it dry sands or simply an extending shoal. But in the *Atlas Novus* (Dutch maps with Latin text) 1640, it is represented as a strip of dry land extending nearly south about six miles. Here it is called *Vlacke Hoeck*—i. e. *Flat Point*. Chatham, on the same map, bears the name *Ongeluckige Haven*—probably from Champlain who named the place "*Port Fortune, for the unhappy circumstances which had befallen us there.*" It is a far better map than Champlain's, showing that more correct information had by this time been obtained.

Des Barres was the most remarkable geographer of the 18th century. Indeed, his maps were only superseded by the Coast Survey. He gives a view

of Monomoy as seen from sea, in addition to his two maps, showing that he fully appreciated its importance to the mariner. It is very remarkable, then, that he should give this peninsula a length greater than it has to-day! Perhaps, as Captain Eldridge says, it was much longer before Egg Island broke off. I am, however, inclined to take the measurements stated in the "Description of Barnstable" as the first positive testimony concerning the true extent of this peninsula. It occurs in stating the position of a humane house, and is meant to be correct.

There are, as I stated in the previous article, plenty of old maps which give different testimony from that which my investigation has reached, but these are only popular pictures of the country, and not trustworthy, especially as regards worthless strips of beach. It was only a few weeks since that a bookseller in Boston showed me an expensive atlas, recently issued, which he regarded as the most complete set of maps in the market, but which failed to give the Monomoy peninsula. Had this work been a *coast pilot*, or assumed to be a collection of *marine charts*, such an omission would have been fatal to its repute, but as it was nothing of this sort, the absence of a sand-bank, however notorious among sailors, was of no consequence to any one likely to purchase such an atlas.

Not wishing, however, to ignore traditions altogether, I append a sketch furnished me by Captain George Eldridge, a resident of Chatham, who is well known as a *practical pilot*, a *surveyor* and a *chart publisher*. This sketch, although *traditional*, as it assumes to be, is confirmed in one important feature at least, in Des Barres' remarkable chart of 1764, in this: that towards the close of the eighteenth century Monomoy was joined to the upland, stopping the passageway from the sound, so that Pleasant Bay was only accessible from the ocean side.

At the time of Des Barres, 1781, Nauset Beach lay along the front of Pleasant Bay and stretched half way down to the present Chatham light-houses, and had advanced *two miles* in the previous *thirty years*. (*Atlantic Neptune*.) Lieutenant (now Rear-Admiral) Chas. H. Davis, writing in 1848, gives as the rate of advance for Nauset Beach from the northward, *two miles in twenty years*, upon the testimony of Capt. Franklin Nickerson, of Chatham.*

One may easily see how the Nauset Beach, composed of alluvia swept down the outside coast by the sea from the north-east, has extended itself along the *resultant* between the ocean waves on the one hand and the outflow of Pleasant Bay upon the other. In this way it has gone on till the too-confined waters of Pleasant Bay have forced a more direct outlet again, and the march of the beach from above has recommenced. The early history of these move-

* Memoirs American Academy, Vol. IV., New Series.

ments is in no wise peculiar ; the same may be observed at many other places upon our sandy coast. But this familiar history seems to be closed.

THE REAL POINT OF INTEREST.

It now appears that Nauset Beach does not extend itself to renew the cordon in front of Chatham, but that the glacial hills, upon which the village stands, are to be thrown open to the fury of the sea, and the place is destined to renew its ancient reputation as the Onge-luckige Haven.

Since our survey of 1847, Nauset Beach, which was found lying nearly across the mouth of Pleasant Bay by Mr. Glück, has not advanced. If this change of regimen is really taking place, to what shall we attribute it? To the failure of supply from above where the cliffs have lost their covering of sand and expose only hard clays to the present wear of the sea? Or is the new order of things the sign of larger operations of the ocean affecting the submerged contours and forcing the sands back upon the continent? Should the supply of new material be really cut off, it is only a question of time when the sea, grinding along the shore, shall convert the present coarse gravel into dune-sand and deliver it to the wind and tide ; for it is in this way that the material of our beaches is to be carried back into the interior or swept into sheltered bays and the advance of the sea continued ; so that, geologically speaking, Monomoy may have but a short life before it.

The clay that underlies the gravel of Cape Cod does not supply *beach-sand*, properly speaking, when sifted by the sea, but ready-made dune-sand and fine material for salt marshes. There is, I think, an interesting significance in this breaking up of the littoral cordon at Cape Cod. We have no other instance like it, that I am aware of. On the contrary, the sand barriers along our coast have generally strengthened since our earliest surveys. For instance, Hatteras Banks, which is a slender strip of sand one hundred and eighty miles in length, lying at some points thirty miles from the main land, has fewer breaks in it to-day than it had at the beginning of this century ; and if we go back to the Raleigh chart, bearing date of 1588, we find that the number of inlets has diminished at least one-third. Mr. Frederick Kidder, who has given much study to the geography of North Carolina, thinks that the diminution in the number of water-ways through the beach has been the indirect result of the destruction of the forests and the cultivation of the soil upon the main land which have diminished the outflow of land-waters.

Glancing at our general coast chart of New England, we see that a region of shallow water extends eastward from Cape Cod and Nantucket to a distance of one hundred and eighty miles, and we might hasten to the conclusion that here lies the foundation of lost lands—washed away by the sea precisely as the present Cape is being destroyed, and this has been frequently suggested by geologists. But since the movements of the ocean are *towards* the continent, where is the material to be found? There are not sufficient beaches, dunes and accumulations in sheltered bays and sounds in this part of the continent to balance such an account. In fact, it takes all the dunes and beaches of Provincetown, Monomoy and the shoals and marshes of Nantucket Sound and Cape Cod Bay to balance the loss of the comparatively narrow belt of land that we see, from the present elevation of the glacial cliffs, must be admitted to have fallen a prey to the waves.

As the glacial cliffs crumble down before the attacks of the sea, there are exposed, a short distance above the reach of storm-waves, as they now occur, rifts of oyster-shells like those of existing species, and the same are found also in wells far back from the coast, showing that, previous to the glacial deposit, there existed a bank extending into the sea, and I suggest that the shallow ground which I have spoken of above as stretching out one hundred and eighty miles to the eastward, may never have been the site of glacial deposits.

There is one little point that I must touch upon here, which is irrelevant to the special subject of this report, but may interest somebody. It is this: The rate at which the coast falls back is not, on our shores, dependent upon elevation, as Sir Charles Lyell believes it to be in parts of England. There are, for instance, all sorts of elevations along the outer margin of Cape Cod, and yet the shore line is remarkably smooth, having no indentations to mark the more rapid encroachments upon low countries. The rapidity of encroachment seems to depend upon the *character of the material* almost exclusively. The glacial drift has been dumped into the sea pell-mell, and, because so badly packed, is peculiarly perishable where attacked by the waves. On Martha's Vineyard, for instance, we have, in the same neighborhood, two lofty bluffs, Nashaquist and Gay Head, which have undergone very unequal erosion from the sea. The former (glacial) is falling rapidly away, while the latter (sedimentary) has been kindly dealt with; one is treated as an intruder upon the ocean's domain, the other as a peaceful settler.

CORRECTIONS OF PREVIOUS PAPER.

In the sketch accompanying my former Report, a portion of Morris Island, marked "D," was stated to be "hillocks." I had not been

on the precise ground at the time, and misinterpreted our topographical map. On revisiting Chatham, a few weeks since, I observed that what I had called "hillocks," were really hills of considerable heights clustered together. Capt. Champlain describes the same locality as "*petis costaux de montaignes*."

Capt. Eldridge objects to my describing the little fresh pond which appears on both Champlain's map and our own as "lying in the hollow of the upland." A careful inspection shows that this pond rests against the upland on one side, and is separated from the sea on the other by a natural dike of alluvium.

Other statements of Capt. Eldridge, not all of them so easily admitted, will be found in his letters and sketch, which I append.

RESULTS OF THE LAST SURVEY.

In the month of November last, Mr. H. L. Marindin, assisted by Mr. J. B. Weir, made another plane-table survey of the coast of Chatham between the parallels $41^{\circ} 39'$ and $41^{\circ} 42'$ covering the area of waste, and he supplies the following tables, which are those previously published, brought up to date:—

Table of Areas of Chatham Beach between Latitude $41^{\circ} 39'$ and $41^{\circ} 42'$.

BETWEEN LATITUDE.	AREA OF BEACH IN THE YEAR—ACRES.						
	1847.	1868.	Loss of Area, 1847 to 1868.	1872.	Loss of Area, 1868 to 1872.	1873.	Loss of Area, 1872 to 1873.
$41^{\circ} 39'$ and $41^{\circ} 40'$.	186	147	— 39	113	—34	66.5	—46.5
$41^{\circ} 40'$ and $41^{\circ} 41'$.	174	71	—103	35	—36	24.5	—10.5
$41^{\circ} 41'$ and $41^{\circ} 42'$.	146	49	— 97	39	—10	44.5	+ 5.5
			239		80		51.5

Loss between 1872 and 1873—28 per cent. of area in 1872.

Table of Distances of Eastern Shore of Chatham Beach West from Meridian 69° 55'.

ON LATITUDE.	DISTANCE WEST OF MERIDIAN IN THE YEAR—FEET.						
	1847.	1868.	Retreat, 1847 to 1868.	1872.	Retreat, 1868 to 1872.	1873.	Retreat, 1872 to 1873.
41° 39' 00" .	6,475	6,075	+400	6,150	—75	6,630	—480
41° 39' 15" .	5,525	5,650	—125	5,802	—152	6,120	—318
41° 39' 30" .	4,925	5,275	—350	5,595	—320	6,140	—545
41° 39' 45" .	4,550	5,005	—455	5,405	—400	Inlet.	—
41° 40' 00" .	4,255	4,795	—540	5,095	—300	"	—
41° 40' 15" .	3,975	4,570	—595	Inlet (1871.)	—	"	—
41° 40' 30" .	3,625	4,285	—660	4,635	—350	5,365	—730
41° 40' 45" .	2,870	3,627	—757	3,895	—268	4,345	—450
41° 41' 00" .	2,060	3,127	—1,067	3,127	+0	2,965	+162
41° 41' 15" .	1,820	3,085	—1,265	3,060	+ 25	3,180	+120
41° 41' 30" .	1,520	4,352	—2,835	5,155	—800	5,180	+ 25
41° 41' 45" .	1,360	N. Inlet.	—	N. Inlet.	—	Inlet.	—
41° 42' 00" .	Inlet.	Inlet.	—	Inlet.	—	"	—

NOTE.—Width of Beach on Latitude 41° 41' in 1847=1,700 feet.

"	"	"	41° 41' in 1868=	590	"
"	"	"	41° 41' in 1872=	590	"
"	"	"	41° 41' in 1873=	820	"

The loss of beach between 1847 and 1868 was at the rate of 11.4 acres per annum; between 1868 and 1872, 20 acres; and for the past year, 51.5 acres,—so that the waste has been going on at an accelerating rate.

The most salient point of the remaining beach, on the parallel of 41° 41', has not wasted, but gained in width during the past year; this, however, seems to be a mere fluctuation.

The upland has been but little disturbed during the past year, but attacks from the sea are so much apprehended, that buildings have been moved back from places where inroads are threatened.

Mr. Marindin has got up for me a series of little sketches of Chatham, which I append, beginning with the map of Champlain, "*rectified*," i. e., put into proper shape, and oriented to the best of our ability. Those points which have not been washed by the sea we supposed to have remained the same, and we have made them the base for determining the positions of other points that have undergone a "*sea change*." Between the time of Champlain, 1606, and the date of our first regular survey, 1847, Des Barres' chart properly comes in, but the scale is smaller, and we should not feel

justified in enlarging a printed sheet. (*See Atlantic Neptune.*) The beach was broken in Des Barres' time, in front of Chatham, and the Monomoy Peninsula hooked on to the upland at James' Head, near the present light-houses. Subsequently, however, Nauset Beach advanced from the northward, and reproduced the *littoral cordon* in front of the town, as shown by Lieut. Davis (before referred to), and finally, before 1847, another inlet opened above, *since which Nauset Beach has not advanced.*

"Ram Island," which, upon the original map of Champlain, was called "*Isle remplis de bois dedans un grand cul de sac* (to quote the exact phrase), obtained its recent name on Des Barres' chart, and still appeared in the survey of 1847, at which time it had an elevation of 20 feet, was used as a pasture, and had a building upon it. The subsequent surveyors found no such island existing.

The dwindling of the beach from date to date is well illustrated by these sketches, upon which we have carefully distinguished upland (glacial drift) from alluvia, by shading the former in lines, the latter in dots.

Very respectfully yours,

HENRY MITCHELL.

Prof. BENJAMIN PEIRCE, *Superintendent U. S. Coast Survey.*

JANUARY, 1874.

COMMUNICATIONS.

(Copy.)

WELLSVILLE, N. Y., November 24, 1873.

DEAR SIR:—Yours of the 18th inst. has been forwarded to me at this place. As you wish me to point out any errors, or state any views I may have, in relation to changes in the vicinity of Chatham and Monomoy Point, I will do so. In reading the pamphlet, I find one important mistake on page 14, thus: in my boyhood (1856) I ran into the Powder Hole in the schooner Bowditch.* The Powder Hole closed to navigation, I think, about 1842. Previous to that time, I had seen fifty sail of vessels packed into it, at one time. What you suppose to be the Powder Hole we call Monomoy Harbor,

* By misquotation, my life is cut a little short. I don't resent this, however; and I am quite willing that the inner lagoon of Monomoy Harbor should claim the name of Powder Hole.

which formed so as to admit of anchorage for a small number of vessels, about ten years after the Powder Hole closed.

Webb's Island, which you mention, I think existed, as I am confident there was an island off Chatham, but not in the locality mentioned in the books. The stumps of hard-wood trees now remain imbedded in tough clay, which shows the trees grew there. This place is by the boatmen called the stump-ground, and in dragging for anchors they never put their lines over until past the ranges of this location or stump-ground. In the summer of 1852, I took up a tree from the bottom at this place, that had the appearance of being petrified. We lost it at the top of the water, as the line caught it by one of the branches, which broke before we could secure it. The color of the tree was slate, dotted with white spots. I tried to sweep it several times afterwards, without success. This tree was about fourteen feet in length, I should judge, with several branches remaining upon it. This stump-ground (so called), as near as I can remember, bears from Chatham Lights from S. E. to S. E. by S. (Magnetic); distance, from two and one-half to three nautical miles; depth of water, from five to seven fathoms. I have seen an old English chart, that my uncle used to have, that laid down a bank called Crab Bank, with two feet of water upon it, about east from Chatham Lights, distance nine miles. Heavy breakers were placed upon the shoal. About two miles within this bank is now where Crab Ledge lies, with not much less than eighty feet water on the rocks.

When I come to Boston, will call at your office, and show you the cause of Monomoy Point extending seaward so rapidly during the last twenty years.

I have established the fact that the main and broken part of Pollock Rip are both moving forward in nearly the same ratio as Monomoy is extending south-westward.

Yours in haste,

GEO. ELDRIDGE,
Hydrographer.

NOTE.—In the *Atlas Novus*, 1640, where the Monomoy peninsula is represented, there appears an island two miles S. E. of Chatham, that may answer for Webb's Island, or for Mr. Otis' point Gilbert of Gosnold—or anything else mysterious. In the English Coast Pilot of 1707, "Manemoy" is represented as an island, and eastward of it we find the words "Webb's Id.," but no island. In the English Coast Pilot of 1787, the words "Webb Island" seem to be applied to Monomoy itself, although "Manomey Point" is several times mentioned in the sailing directions. In the same edition. "Crab Bank" is represented upon a chart entitled "Map of the Coast of New England from Staten Island to the Island of Breton, as it was actually

surveyed by Capt. Cyprian Southack," where it appears as a rectangular patch, covering about one hundred and sixty square miles, and extending southward from the latitude of the Highlands to the latitude of Chatham. The same chart gives an opening from Cape Cod Bay to the ocean near Chatham, makes Monomoy "Webs Island," and robs Nantucket Island of Great Point and Brant Point. Des Barres' chart, bearing date two years earlier, gives a warning line of dots about the space afterwards called Crab Bank, but no shallow water; joins Monomoy to the upland of Chatham, and gives Nantucket so nearly as at present that no unprofessional eye could detect the difference. Des Barres' map of New England represents the coast of Massachusetts more nearly as it is to-day than many popular maps published within the last ten years, and greatly discredits the so-called "*actual survey*" of Cyprian Southack. Our first survey over the site of the supposed "Crab Bank" gave us from 140 to 360 feet of water; so we omitted the warning dots of Des Barres, and ignored Cyprian Southack altogether.

The Crab Bank on Southack's map seems to have been copied from "*Le petit Atlas Maritime*" of 1764.

Egg Island has something more than a *traditional* history. It has been *made* famous. In the *Antiquitates Americane* it is referred to triumphantly as fixing "*precisely*" one of the land-falls of the Northmen—the Sagas having mentioned the finding of eggs upon an island somewhere to the south-westward of Greenland. I think this island, or its offspring, may still be said to exist, there being a dry shoal some distance off Monomoy to-day.

H. M.

(Copy.)

WELLSVILLE, December 15, 1873.

DEAR SIR:—Since I wrote you I have carefully read your pamphlet, and find you make no mention of the important passage between Inward Point and Stewart's Hill. From the oldest men (when a boy) I was told that this passage was navigable many years for vessels of 10 or 12 feet draught. Captain Stewart, who kept a tavern at Wreck Cove for many years, was the principal pilot for this passage. The Hill and Bend on the Sketch, bore his name. It appears that the settlement at Wreck Cove at the above time was larger than at any other part of Monomoy since.

Stewart's Channel must have been deep, as the current has carried the sand into Chatham Bay, nearly $2\frac{1}{2}$ miles from the opening. (*See Sketch of Common Flats.*)

We are also told that one time Monomoy Point extended farther westward than at any time since; but during a violent storm and high tide, a passage was opened, leaving several islands to the westward, the largest of which was called Egg Island; after a lapse of some years, these islands were destroyed, and the point extending

westerly formed what was called Powder Hole.* Lastly, we have Monomoy Harbor, which has also been destroyed.

At the above time the beach from Inward Point joined Morris Island, with an opening between James' Head and the island. A connection was formed between Nauset and Monomoy beaches about 1855.

From the old pier (a part of which now remains to view) the course was about S. E. to sea, leaving Nauset Beach Point on the port hand.

Stewart's Bend was on what is called the back side of the beach at sea, and only afforded shelter to vessels with winds from W. S. W. to N. N. W. (*See Sketch.*)

I am rather inclined to the opinion that the existence of Monomoy as dry land, does not date back a great number of years from 1684, as we are told sea-weed (or eel-grass) was unknown both in Oyster Pond and Chatham Bay, until about 1750. My experience is, that eel-grass will not grow unless the temperature of water is considerably above that of the ocean. Sea-weed, during the last fifty years, has grown in great abundance in Chatham Bay.

The greatest changes in the vicinity of Chatham appear to have taken place in the Oyster and Mill Ponds. These ponds at one time must have been swamps, with many large trees, as we find at low-water mark, a short distance beneath the surface, peat with leaves, and the remains of maple and hard-pine roots, which are deeply and firmly imbedded in the peat. It is therefore evident that these trees could not have grown in salt water.

Many rocks are found between Chatham and George's Bank, but *stumps in seventeen fathoms of water* are unknown to me.

If I remember, the fresh pond on Morris Island is not on the upland (or main land), but on the beach.

I am inclined to the opinion that this stump-ground off Chatham had no connection with the main land, as I find the bottom (which is of clay) for some distance within to be clear of stumps. After a heavy gale, I have seen at one time, a number of these stumps on shore, at Monomoy Beach; do not remember ever having seen the marks of the axe upon them. A short distance to the westward of the stump-ground, is a large white rock, called by the fishermen "South-east Rock." I have forgotten the ranges, but have fished for cod many times upon it.

GEORGE ELDRIDGE.

* This hole, or hook, received its name from the large quantity of powder burned in shooting ducks flying across the narrow strip of sand, from Chatham Bay to Nantucket Sound.

NOTE.—Mr. Chapin furnishes the tradition that *Powder Hole* is a corruption of the original name *Powder Horn*. He says that the north-west point of Monomoy Harbor, in beating back to the eastward, has crossed a wharf which formerly lay *inside*, but which is now outside of the beach, and exposed to Nantucket Sound. He also calls my attention to one fact that I quite overlooked, viz.: that in the "Description of Barnstable," Stewart's Bend is referred to as lying on the *east* side of the beach—which seems to confirm Captain Eldridge's statement. Still, I am at a loss to account for the statement in the "Description," that this bend furnished "*shelter for vessels in three or four fathoms.*" Des Barres' map (1781) gives two or more shallow curves in the outside shore, but nothing that could be called a shelter. On the inside, however, he gives bights near the sites of "Wreck Cove" and "Powder Hole" as they afterwards were called.

Stewart's Channel, which divided Monomoy into two parts, does not appear upon either of Des Barres' charts.

H. M.

REPORT OF GEN. GEO. THOM.

UNITED STATES ENGINEER OFFICE, BOSTON, MASS., January 19, 1874.

HON. JOSIAH QUINCY, *Chairman Board of Harbor Commissioners, Boston, Mass.*

SIR:—I have the pleasure of furnishing, in compliance with the request contained in your letter of the 31st ultimo, a copy of my report to the Chief of Engineers, on the several works under my charge, for the improvement of harbors and rivers in the State of Massachusetts, for the six months ending December 31, 1873.

Very respectfully, your obedient servant,

GEORGE THOM,

Lieut. Col. of Engineers, B't Brig. Gen. U. S. A.

I. IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

The several works now projected and in progress for the improvement and preservation of this harbor, consist of the following, viz.:—

1. The sea-wall for the protection and preservation of Point Allerton;
2. The sea-wall for the protection and preservation of Great Brewster's Island;
3. The sea-wall for the protection and preservation of Lovell's Island;
4. The sea-wall for the protection and preservation of Gallop's Island;
5. The sea-wall for the protection and preservation of Long Island Head;
6. The sea-walls for the protection and preservation of Deer Island;
7. Straightening, widening and deepening the main ship-channel at "The Narrows";
8. Widening and deepening the channel through the "Upper Middle Bar";
9. Completing the removal of Kelly's Rock;
10. Removal of a sunken ledge situated in "The Narrows," between George's Island and Brewster's Spit;
11. Removal of the wreck of schooner Delos;
12. Removal of State Rock and Palmyra Rock;
13. Survey of sunken rocks.

I. *Sea-wall on Point Allerton.*

Work upon this sea-wall was commenced in September, 1870, and has been continued up to the present time, for the most part under contracts with Mr. James M. Andrews, of Biddeford, Me., made, respectively, May 24, 1870, July 26, 1871, August 24, 1872, and May 8, 1873; the last of which provided for *completing* this sea-wall, at the same prices as in the preceding contracts, viz.:—

1. Granite wall (including granite facing and coping, concrete foundation and back-filling), at \$77.90 per linear foot;
2. Concrete for additional foundation, if required, in excess of that called for by the drawings and specifications, at \$11 per cubic yard;
3. Excavation for foundation, at \$1 per cubic yard;
4. Back-filling, at 50 cents per cubic yard;
5. Paving (including paving-stones, and the cobble-stones, shingle and granite for bedding for same), at \$6.40 per superficial yard.

The contractor commenced work under his last contract early in May, 1873, and up to the 30th of June he had finished 145 linear feet of *granite wall* proper, $593\frac{3}{4}$ cubic yards of *excavation* for the foundation, and 2,008 cubic yards of *back-filling*. This work was continued by him until the 12th of December, when it was suspended until the spring of 1874, with the following additional result, viz.:—

132 $\frac{21}{100}$ linear feet of wall built in total completion of the wall proper to the projected length, 1,200 feet;

595 $\frac{58}{100}$ cubic yards of excavation, in total completion of same;

2,406 $\frac{1}{2}$ cubic yards of back-filling; and

1,448 $\frac{1}{3}$ superficial yards of granite paving.

In addition to this contract work, there has been laid a rubble-stone apron, with jettées, for protecting the concrete foundation of the wall, for an extent of 915 feet, commencing at the westerly end of the wall, that being the part which is most exposed to injury from storms. This apron has a width of 10 feet; and the jettées, five in number, have each a length of 25–30 feet, and a width of six feet, four of which are built at the westerly angle of the sea-wall, and one at the middle of the second face from the westerly end.

The total cost of these jettées and apron-work, was \$4,793.55.

The work that now remains to be done for the total completion of the sea-wall, consists of 452 superficial yards of *granite paving* and 900 cubic yards of *back-filling*, the cost of which, as contracted for, will be \$3,342 80

Amount due as percentage retained on contract work

done to date, 6,852 07

Adding for contingencies, say 805 13

Total, \$11,000 00

II. *Sea-wall on Great Brewster's Island.*

This wall, which was built for the protection of the north and south heads of the island, was commenced in 1849, and completed in 1870.

An inspection of the work shows that it fully answers the purpose for which it was intended, and that it continues to be in good condition, requiring at present no repairs.

III. *Sea-walls on Lovell's Island.*

There are two sea-walls on this island, one of which was built thirty years ago, for the protection of its north head; and the other in 1867 and 1868, for the protection of the south-east bluff for a length of about 800 feet.

An inspection of these sea-walls, made in the latter part of March, 1873, showed—

1. That the old wall on the north head was in good condition; but that the long jetty at its southern extremity was much shattered by the storms and currents, and that the shore-line south of the wall, for a distance of about 600 feet, had been much abraded of late years, to a degree threatening serious changes, the immediate prevention of which was absolutely necessary. For this purpose, it was recommended that the jetty be repaired, and that an apron-work of large rubble-stone be built for the protection of the shore south of it for a length of 620 feet; and

2. That the sea-wall at the south-east bluff was in good condition, not requiring any repairs; but that the shore-line, next to its southern extremity, had become worn away for a length of 110 feet, for the preservation of which a stone apron was recommended, to be 18 feet in width and three feet in height.

Work was commenced, with hired labor, upon the north wall in May, 1873, and was completed in July following; and the apron upon the shore next to the sea-wall at the south-east bluff was completed early in August.

IV. *Sea-wall on Gallop's Island.*

This sea-wall was commenced in 1868, and was completed, with the exception of some grading of the bluff in its rear, in the latter part of September, 1871, when work upon it was suspended.

The violent storms and currents to which this wall is exposed laid bare its foundations of concrete to such a degree as to necessitate, for its protection and preservation, a rubble-stone apron throughout its whole length, with jettées at the angles of the faces.

This work was commenced early in August, 1873, with hired labor, and continued until the middle of October, during which time

1,210 linear feet of apron-work, and five stone jettées, were built. On the most exposed faces of the wall this apron was 10 feet in width, whilst, at the two outer faces, it was but five to six feet wide. The quantity of stone used in this apron-work was over 800 tons. Seven stone jettées were also built along the wall, five of which are of split granite, bedded, in part, in concrete laid in trenches, and surrounded with a concrete apron, having a length of 18 feet, and a width of four feet. These five split-stone jettées were placed at the most exposed angles of the wall; and two others of rubble-stone, respectively 12 and 25 feet long, were placed at the middle of the first face (counting from the east), and at the reëntering angle formed by the first and second faces. About 225 tons of split stone have been used in the jettées.

To complete this apron-work to the extent necessary for the thorough protection of this wall, on the first, seventh, and eighth faces, will require about 650 tons more of rubble-stone, the estimated cost of which, laid on the work, is, at \$4 per ton, \$2,600.

V. *Sea-wall on Long Island Head.*

Work was commenced upon this sea-wall in August, 1870, and has been continued up to the present time, for the most part under contracts with Mr. James Andrews, of Biddeford, Me., made, respectively, May 24, 1870, July 26, 1871, August 23, 1872, and May 8, 1873, the last of which provided for completing this sea-wall at the same prices as in the previous contracts, viz.:—

1. Granite wall (including granite facing and coping, concrete foundation and backing), at \$58.19 per linear foot;

2. Concrete for additional foundation, if required, in excess of that called for by the drawings and specifications, at \$10.25 per cubic yard.

3. Excavation for the foundation, at \$1 per cubic yard.

4. Back-filling, at 50 cents per cubic yard.

5. Paving, (including paving-stones, and the cobble-stones, shingle and gravel for bedding for same), at \$5 per superficial yard.

The contractor commenced work under his last contract early in May, 1873, and up to the first of July he had finished $161\frac{37.5}{1000}$ linear feet of the *granite wall* proper, $558\frac{9.5}{100}$ cubic yards *excavation* for the foundation, and 1,300 cubic yards of *back-filling*. This work was continued by him until the first of December, when it was suspended until the spring of 1874, with the following additional results, viz.:

380 $\frac{1}{2}$ linear feet of wall built, in total completion of the wall proper, to the projected length of 2,080 feet;

776 $\frac{7}{8}$ cubic yards of excavation, in total completion of same;

2,920½ cubic yards of back-filling; and
1,546⅔ superficial yards of granite paving.

The work that now remains to be done, under this contract for the entire completion of this sea-wall, consists of 1,838½ superficial yards of granite paving, and 1,450 cubic yards of back-filling, the cost of which will be \$9,916 66

In addition to which there will be necessary for the protection of the foundation on the second and third faces of the wall (counting from the east), 320 linear feet of rubble stone-apron, and six jet-tées, requiring 500 tons of stone, the estimated cost of which, laid in the work, at \$4 per ton, is 2,000 00

Amount due as percentage retained on contract work to date, 8,540 04

Adding, for contingencies, say 1,543 30

Total, \$22,000 00

VI. *Sea-walls on Deer Island.*

The three sea-walls on this island were built about thirty-five years ago, for the protection and preservation of the north, middle and south heads, and were respectively 1,740, 840 and 420 feet in length. The injury which these walls had sustained from the violence of the storms, was such as to necessitate the rebuilding of them to a great extent. This was commenced in 1865, and completed in 1869; not, however, to the extent that has since proved to have been necessary. On an inspection of them, made in the latter part of March, 1873, it was found that in numerous places, the stone in the lower course of the north head wall had been moved out of place, that the granite paving in the rear of this wall, for a length of 68 feet, had still to be completed, and that about 70 linear feet of the old paving required relaying, and that the wall otherwise needed repairs.

These repairs were taken in hand, with hired labor, on the 15th of October, and were completed early in November, 1873.

VII. *Straightening, Widening and Deepening the Main Ship Channel at "The Narrows."*

This work consists in the removal of portions of Brewster's Spit and Lovell's Island, so as to obtain a depth of 23 feet at mean low water, for a width of 600 feet, with proper slopes up to the 18-foot curve.

Work was commenced on Lovell's Island in 1867, and continued during that and the two following years, until suspended for want of funds. The officer then in charge of this work reported that by these operations, the whole south-west point of this island was cut

off for a width of 260 feet from the top of the bank in a regular slope to a depth 23 feet at mean low water ; and that the channel at that point had been widened at the depth of 18-feet curve from its former width of 365 feet to 625 feet.

With a view to ascertaining the condition of the channel in "The Narrows" and its vicinity, and what changes, if any, had taken place therein since the completion of the improvements there, including the enlargement of the channel at Lovell's Island, a re-survey of that locality was made, under my direction, in July and August, 1872, by my assistant, Mr. H. F. Bothfeld, civil engineer, whose report thereon and map, dated February 18, 1873, accompanied my report for the fiscal year ending June 30, 1873. On referring to this map, it will be seen that the channel at the south-west point of Lovell's Island has not changed, to any considerable extent, since the dredging operations were closed in 1869 ; that the 18-feet curve is now very nearly the same as it was then ; and that the shore above low-water line has acquired a more natural slope of eight feet horizontal to one foot rise, by the receding inland of the high-water line ; also, that the flats off the south-east point of Lovell's Island have advanced so much towards the main channel as to materially impede and endanger navigation. It will also be seen that the extreme westerly end of Brewster's Spit has continued to extend in a westerly or south-westerly direction, the point on low-water line being 120 feet further out than in 1860, and the present 18-feet curve 168 feet from that of 1860.

The removal of a portion of this spit was originally projected, but as yet it has not been commenced for want of funds. It is, however, now highly necessary that it should be done as soon as practicable, at the same time with the work projected on the south of Lovell's Island.

The estimated cost of the improvement of "The Narrows," by the excavation from Lovell's Island, to a depth of 23 feet at mean low water, for a width of 600 feet, with proper slopes inward, and by excavating Brewster's Spit, as shown on the drawing above referred to, is as follows, viz. :—

1. Lovell's Island, 40,000 cubic yards dredging, on south-east point, at 60 cents,	\$24,000 00
40,000 cubic yards dredging on south-west point, at 60 cents,	24,000 00
2. Brewster's Spit, 60,000 cubic yards dredging, on westerly extremity of the spit, at 60 cents,	36,000 00
Adding for contingencies, say	6,000 00
Total,	<hr/> \$90,000 00

VIII. *Widening and Deepening the Channel through the Upper Middle Bar.*

The improvement projected for this bar consists in opening through it a channel to a width of 600 feet, and a depth of 23 feet, at mean low water, the average length of the "cut" being 2,200 feet, with an excavation of from one to seven feet.

The work done up to the first of July, 1873, amounted to the excavation of 46,425 cubic yards, by which an entire "cut" was completed to a width of 40 feet and a length of 1,800 feet, and a second "cut" completed for a length of 1,040 feet and to a depth of 23 feet at mean low water—including the removal of a large boulder (discovered in the channel in 1872), having but 16½ feet of water on it at mean low water.

To complete this channel to the width of 600 feet as projected, will require about 230,000 cubic yards of additional dredging, the estimated cost of which, including contingencies, is \$182,500 00 Under the appropriation of March 3, 1873, there is

available for this work the sum of	.	.	.	54,477	40
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Which will be applied thereto as soon as practicable, should favorable proposals be received from responsible parties for doing the work by contract.

IX. *Completing the Removal of Kelly's Rock.*

This rock lies in the main ship-channel, about 700 yards to the eastward of Bug Light, and directly in the line of entrance buoy No. 1 and Bug Light.

In the autumn of 1869, operations were commenced upon this ledge for its removal, by blasting, to a depth of 23 feet below the plane of mean low water; and they were continued up to the end of December, 1870. These operations were resumed in June, 1873, and were continued until the 25th of July following, during which time 118 tons of rock were removed. An accurate survey, since made, shows that there is still an area of about 320 superficial yards of this ledge which has less than the projected depth, on the shoalest parts of which there are but 21½ feet of water at mean low water. In order to obtain the full depth of 23 feet at mean low water, the additional removal of not less than 80 cubic yards will be required, the estimated cost of which is \$4,000.

X. *Removal of a Sunken Ledge, situated in "The Narrows," between George's Island and Brewster's Spit.*

This ledge was discovered in September, 1872, in a re-survey of "The Narrows," made under my direction, by my assistant, Mr. H.

F. Bothfeld, civil engineer; and a careful re-survey of it was made in July, 1873; a drawing of which is hereto appended. It is situated near the middle of the main ship-channel, directly in the track of all large vessels, and particularly of the European steamers; and is distant 317 yards in a direction west by south from Bug Light. It is an outcropping of ledge of argillaceous slate, with its laminations much contorted. In its longest direction it lies obliquely to the channel, running from north to south-east by east for 41 feet, with an average width of nearly 10 feet, its highest point having but 18.9 feet of water upon it at mean low water. Its area in the plane of 23 feet below mean low water is $44\frac{1}{3}$ square yards, and its cubic contents above this plane is $16\frac{1}{8}$ cubic yards.

The removal of this ledge to a depth of 23 feet at mean low water is recommended; the estimated cost of which is \$1,000.

XI. *Removal of the Wreck of the Schooner "Delos."*

This vessel, of about 100 tons, deeply loaded with gravel in her hold and on deck, was sunk in the gale of November 12, 1872, in Nantasket Roads, about 100 yards from Fort Warren wharf, in about 22 feet of water, and had about 14 feet of water over it at mean low water.

The removal of this wreck was completed in the early part of June, 1873.

XII. *Removal of State Rock and Palmyra Rock.*

In August and September last, an extended survey was made of the southern portion of the Lower Middle Shoal, on the southerly spurs of which are situated the ledges known as State Rock and Palmyra Rock. In that survey over 2,000 soundings and 40 borings were made south of a line connecting buoys Nos. 8 and 10, covering an area of about 40,000 square yards; showing that this part of the shoal ground consists of a top layer of sand, gravel and shells, averaging one foot in thickness, resting in some places immediately upon solid ledge, whilst in other places hard clay, from one to three feet in thickness, intervenes. In very many places the solid ledge crops out (sometimes resembling boulders, but more frequently ragged or pointed peaks or combs), forming two spurs (marked "a" and "b" on the accompanying sketch*). The depth on these spurs varies generally from $15\frac{1}{2}$ to $18\frac{1}{2}$ feet at mean low water. The shoalest place was found at the point marked "p," where there is an outcropping of the ledge, the top of which is but $8\frac{1}{2}$ feet below the plane of mean low water, whilst the surrounding bottom is about

* The sketch is omitted.

13½ feet below that plane. At the point marked “m,” there is another outcropping of the ledge, the top of which is about 10 $\frac{3}{10}$ feet below the plane of mean low water—the depth around it being about 16½ feet. The outcropping at “m” has an extreme length of 27 feet and a width of 10 feet in the plane of 16½ feet below mean low water, with a height of 6 $\frac{2}{10}$ feet above that plane, and contains about 28 cubic yards of ledge. The outcropping at “p” contains about 12 cubic yards above the surrounding bottom.

These two points of ledge (marked “m” and “p”) form what is known as State Rock, and are the most dangerous parts of this shoal; that at “m” (as shown by the copper and other parts of vessels found around it) having been struck by vessels, including, it is said, the steamer Norman.

The shoal place, marked “a,” is that on which the steamer Palmyra is believed to have first struck in 1872, and by some is called Palmyra Rock.

To reduce this whole shoal to a plane of 23 feet below that of mean low water, outside the line *m n* on an area of about 18,600 superficial yards, would require the removal of about 43,000 cubic yards of ledge, which would involve an enormous outlay. Whilst the removal of the two outcroppings of the ledge at the points “m” and “p,” the most dangerous obstacles to navigation, would require the removal of but 40 cubic yards, at an estimated cost of \$2,000.

The removal of these two points, with a more suitable placing of buoys 8 and 10, would greatly improve the navigation of this shoal, and it is recommended to be done as soon as practicable.

A special report on the survey of this shoal will be forwarded on the completion of the drawings, now well advanced.

XIII. *Survey of Sunken Rocks.*

The discovery, in September, 1872, of an unknown rock in the the main ship-channel at “The Narrows,” in the vicinity of Tower, Corwin and Kelly’s Rocks, created a doubt as to the existence of other unknown rocks in that vicinity.

In July, 1873, a careful examination of this channel was made by *dragging*, for several days, between Corwin Rock and the north-west point of George’s Island, and by taking a large number of range and random soundings east of Kelly’s Rock; but without discovering any new rocks having less than 23 feet of water over them at mean low water.

A similar examination has also been made over the shoals east of Great and Little Faun in Broad Sound, in order to ascertain the locality of certain dangerous rocks, the existence of which has been reported. But after a careful and extended search over an area of

1,000 by 500 feet, which was found to be covered with numerous bowlders, of various sizes, no rocks were found having less than 13 feet of water over them at mean low water.

The navigation of the north channel is almost always dangerous, and is especially so at low water.

To remove all the rocks that would be necessary, should the improvement of the navigation of this place be undertaken, would cost much more than would be warranted by the benefit thereby gained.

Nash's Rock.—This “rock” (so called) lies in the entrance to the harbor, about one-third of the way over from Brewster's Spit to Point Allerton. It consists of several acres of shoal ground, having an average depth of 22 to 23 feet at mean low water, covered with a dense mass of coarse gravel, shingle and *bowlders*, in some places lying upon clay.

In a survey of this shoal, made in September, 1873,—in which about 3,400 soundings were made over an area of from 16 to 18 acres,—no solid ledge was found anywhere; and the *least* depth found was 15 feet below mean low water, which was over a large bowlder, weighing perhaps forty tons. A special report on this survey will be forwarded on the completion of the drawings now in hand.

In connection with the foregoing surveys, observations have been made at Lovell's Island, during the past season, on the rise and fall of the tides, during a period of three lunations: and the plane of *mean low water*, as determined thereby, has been marked by permanent benches, for future reference, in the improvements to be made in that part of the harbor.

Similar observations were also taken during the months of August, September and October, at the wharf of Fort Independence, on Castle Island, preparatory to a continuance of the dredging at the Upper Middle Bar.

In the work heretofore projected for the preservation and improvement of Boston Harbor, the attention of the department has not been called to the condition of the low land near the southern extremity of Long Island, and its bearing upon the preservation of Sculpin Ledge Channel. During the extraordinary gale of the 7th–11th of October last, this low land was overflowed, and so washed out as to create serious apprehensions as to the danger that might ensue to that channel. A survey was at once made of this locality, in order to determine its condition, and to ascertain what changes, if any, had taken place since the survey of 1860, as well as the cause of those changes. This survey showed that both the eastern and western shore crests of the low neck of land which

connects the south head with the main part of Long Island, had been considerably weakened, in width as well as in height, since 1860; but that the main portion of the low land did not appear to have changed, since then, in character or level; also, that Sculpin Ledge Channel had been somewhat encroached upon—the 12-foot curve being about 60 feet further from the shore than in 1860.

It moreover appeared, on investigation, that all the damage done to those crests was caused by the removal, for sale, of a very large quantity of stone ballast, shingle, gravel and sand, from the shores, by the owner of the land, with the permission of the municipal authorities of Boston—from 10,000 to 12,000 tons of gravel having been removed to *one* wharf in Boston, between the first of June and September.

In order to prevent, as far as practicable with a small outlay, any further immediate damage to those crests, their lowest and weakest portions were raised and strengthened throughout, so as to have a height of not less than $2\frac{1}{2}$ feet above the plane of mean high water. But afterwards, another gale, of still greater violence, occurred on the 16th–18th of November, whereby this low land was again overflowed, the tide itself having risen higher than most parts of the shore crests. None of the gaps of the crests, which were closed a few days previously, were opened by this storm; but close to, and south of what was formerly the most northern gully in the crest of the western shore, another wider, if not deeper, depression was made, through which the tide will enter at nearly every high water; besides which, the shore crests, for an extent of two or three hundred feet, were lowered about one foot.

The attention of the city government of Boston has been called to this matter, and it is hoped that such action will be taken by it as may be necessary for the protection and preservation of this channel.

The following is a recapitulation of the estimated cost of the several works projected for the further improvement of Boston Harbor, viz.:—

1. Completion of sea-wall on Point Allerton, including contingencies,	\$11,000 00
2. Completion of sea-wall on Gallop's Island, including contingencies,	2,600 00
3. Completion of sea-wall on Long Island, including contingencies,	22,000 00
4. Straightening, widening and deepening the main ship-channel, at "The Narrows," including contingencies,	90,000 00

5. Completion of the channel through the Upper Middle Bar, including contingencies,	\$182,500 00
6. Completing the removal of "Kelly's Rock,"	4,000 00
7. Removal of newly discovered rock in "The Narrows,"	1,000 00
8. Removal of State Rock,	2,000 00
Total,	<u>\$315,100 00</u>
Amount available January 1, 1874,	90,077 40
Additional amount required,	: <u>\$225,022 60</u>

Or, say, \$225,000.

Of the amount now available, viz.,	\$90,077 40
there will be required for the first three items, as above estimated, the sum of	35,600 00
Leaving,	<u>\$54,477 40</u>

This amount will be applied, as soon as practicable, to the improvement of the Upper Middle Bar, agreeably to the adopted project.

II.—IMPROVEMENT OF MERRIMAC RIVER, INCLUDING THE HARBOR OF NEWBURYPORT, MASSACHUSETTS.

The following appropriations have been made, to this date, for the improvement of Merrimac River, viz.:—

By Act of July 11, 1870, for improvement of Merrimac River, Massachusetts,	\$25,000 00
By Act of March 3, 1871, for improvement of Merrimac River, above Haverhill, Massachusetts,	25,000 00
By Act of June 10, 1872, for improvement of Merrimac River, above Haverhill, Massachusetts,	25,000 00
By Act of March 3, 1873, for improvement of Merrimac River, Massachusetts,	25,000 00
Total,	<u>\$100,000 00</u>
Amount expended up to July 1, 1873,	51,305 53
Amount available July 1, 1873,	<u>\$48,694 47</u>

Up to that period (viz., July 1, 1873), the work done was as follows, viz.:—

1. The main (South) Gangeway Rock, in Newburyport Harbor, Mass., was broken up and removed in 1870, to a depth of $9\frac{1}{2}$ feet

2. Removing "The Boilers," near the city wharves,	\$6,000 00
Adding for contingencies, say	2,000 00
Total,	<u>\$22,000 00</u>

II.—*River between Newburyport and Haverhill, Massachusetts.*

1. Removal of Gangeway Rock, 14 cubic yards, at \$20,	\$280 00
2. Removal of two rocks above Deer Island bridge, 108 cubic yards, at \$20,	2,160 00
3. Removal of rocks at Rocks Bridge,	1,000 00
4. Removal of Little Currier Rock, 2 cubic yards, .	25 00
5. Dredging at Currier Shoal, 6,500 cubic yards, at 75 cents,	4,875 00
6. Dike at Silby's Head, 350 feet, at \$25,	8,750 00
Adding for contingencies, say	1,910 00
Total,	<u>\$19,000 00</u>

III.—*River above Haverhill, Massachusetts.*

1. Excavating a channel, 60 feet wide, and 4 feet deep at low water, in the summer stage of the river, at Hazletine Rapids, 1,900 cubic yards, at \$4.95,	\$9,405 00
2. Completing the channel, to the same width and depth, at the Lower Falls, 2,500 cubic yards, at \$4.95,	12,375 00
3. Completing the channel to the same width and depth, at the Upper Falls, 2,800 cubic yards, at \$4.50,	12,600 00
Adding for contingencies, say	4,045 00
Total,	<u><u>\$38,425 09</u></u>

Total amount required for completing all the projected improvements, as above,	\$79,425 09
Of which there is now available under ex- isting appropriations,	\$33,082 97
Deducting amount of percentage retained on contract work,	3,657 88
	<u>29,425 09</u>
Additional amount required,	<u>\$50,000 00</u>

III. IMPROVEMENT OF GLOUCESTER HARBOR, MASSACHUSETTS.

By an Act of Congress approved June 10, 1872, the sum of \$10,000 was appropriated for the removing of rocks in this harbor. Under this appropriation a contract was made August 26, 1872, with Mr. Geo. W. Townsend, of Boston, Massachusetts, for removing the following sunken rocks at the prices named, viz.:—

1. Babson's Ledge, at \$20 per cubic yard.	
2. Clam Rock,	\$450 00
3. Pinnacle Rocks,	1,170 00
4. Rocks off J. Friend's wharf,	330 00
5. Rock off Pew's wharf,	45 00

On the first of July, 1873, all the work contracted for was completed, viz.:—

1. Clam Rock, removed from a depth of one foot to that of $9\frac{1}{2}$ feet below the plane of mean low water, the level of the surrounding bottom.

2. Pinnacle Rocks, removed from $8\frac{1}{2}$ feet above, down to the level of the surrounding bottom, which has a depth of $16\frac{1}{2}$ feet below the plane of mean low water.

3. Rocks off J. Friend's wharf, removed down to the level of the surrounding bottom.

4. Rock off Pew's wharf was entirely removed to a depth of five feet below mean low water.

5. The largest bowlders were removed from the rocky shoal known as "Babson's Ledge."

Amount available July 1, 1873, for additional work \$747.64, which is still available, as work has been suspended since that date.

IV. IMPROVEMENT OF SALEM HARBOR, MASSACHUSETTS.

The following is an estimate of the cost of the work projected for the improvement of this harbor, viz.:—

1. Excavating a channel 1,730 feet long, and 300 feet wide to a depth of eight feet at mean low water (giving $17\frac{3}{10}$ feet at mean high water) from the entrance to South River outwards to deep water, including contingencies,	\$32,000 00
2. Constructing a sea-wall and a breakwater for the preservation and protection of Long Point, including contingencies,	23,000 00
Total,	<hr/> \$55,000 00

By Act of Congress approved March 3, 1873, there was appropriated for this work the sum of \$15,000.

After advertising for proposals, a contract was made May 1, 1873, with Mr. Augustus R. Wright, of Geneva, N. Y., the lowest of four bidders, for 30,000 cubic yards, more or less, of dredging at 44 cents per cubic yard, as measured in the scows. On the 10th of May he commenced work, and up to the close of the fiscal year ending June 30, 1873, he had dredged $9,266\frac{1}{2}$ cubic yards under this contract. After a suspension of work on the 5th of June, it was resumed on the 8th of December, from which date up to the 31st of the month $6,405\frac{14}{100}$ cubic yards of dredging were done, making a total to date of $15,671\frac{64}{100}$ cubic yards. By this work the channel has been opened to the required depth of eight feet at mean low water, from the mouth of South River outwards to deep water, for an average width of 90 feet.

Amount available July 1, 1873,	\$11,455 51
Amount expended since,	2,513 14
	<hr/>
Amount available January 1, 1874,	\$8,942 37

V. IMPROVEMENT OF DUXBURY HARBOR, MASSACHUSETTS.

The following appropriations have been made for the improvement of this harbor, viz. :—

By Act of Congress approved June 10, 1872,	\$10,000 00
By Act of Congress approved March 3, 1873,	10,000 00
	<hr/>
Total,	\$20,000 00

Under these appropriations contracts were made, November 7, 1872, with Mr. Augustus R. Wright, of Geneva, N. Y., for 17,000 cubic yards, more or less, of dredging, at 50 cents per cubic yard; and May 6, 1873, with Mr. Hugh Cummiskey, of Boston, Mass., for 18,000 cubic yards, more or less, of dredging, at 49 cents per cubic yard; in the south channel of this harbor.

This channel extends from the "Cow Yard," so called, up in a north-westerly direction between Captain's Hill and Kingston Flats, for a distance of about three miles. For a distance of $2\frac{1}{2}$ miles it has a width of not less than 200 feet, with $11\frac{1}{2}$ feet of water at mean low water (or about 21 feet at mean high water); and for the remaining distance the channel is narrow and crooked, having a width of not more than 80 feet for a depth of eight feet at mean low water.

The improvement projected for this harbor consists in straightening and widening the upper portion of the channel, so as to have a width of 150 feet for a depth of eight feet at mean low water, requiring about 35,000 cubic yards of dredging; for which the contracts were made.

Up to the 1st of July, 1873, 2,638 cubic yards had been dredged by Mr. Cummiskey under his contract of May 6, 1873. This work was continued by him until the 22d of August, when he completed his contract by the additional dredging of $16,360\frac{3}{10}$ cubic yards, making a total of $18,998\frac{3}{10}$ cubic yards.

Operations were commenced in September, under Mr. Wright's contract, and were continued until the 3d of December, 1873, when they were suspended until the return of favorable weather in the spring of 1874,—9,686 cubic yards having been dredged to date, leaving about 7,000 cubic yards yet to be done under this contract. This work is to be completed on or before the 31st of May next.

Amount available July 1, 1873,	\$18,639 54
Amount expended since,	14,057 67
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Amount available January 1, 1874, including the percentage retained on contract work,	\$4,581 87

VI. IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

The work projected for the preservation and improvement of this harbor, consists in the construction and repair of bulkheads and jetty, composed either of stone or else of timber and brush ballasted with stone, built for the preservation of Long Beach, and for its protection from the storms to which it is exposed. This beach serves as a breakwater, and affords to the harbor its only protection from the easterly storms.

The following appropriations have been made by Congress for this work, viz.:—

By Act approved July 11, 1870,	\$10,000 00
By Act approved March 3, 1871,	10,000 00
By Act approved June 10, 1872,	2,500 00
By Act approved March 3, 1873,	3,000 00
<hr/>	
Total,	\$25,500 00

of which amount there was available July 1, 1873, . . . \$4,288 85

The work projected for the further improvement and preservation of this harbor, with this available amount, consisted in the "enlargement and inward extension of the stone bulkhead; the repair of the brush bulkhead and jettées, the planting of beach-grass, and to the extension of the stone jettées, where necessary. This work was commenced on the 1st of August, 1873, and prosecuted, with hired labor, until the latter part of November, 1873, when it was suspended for the winter. During this period the work done was as follows, viz.:—

Nineteen groins of brush and stone, having a total length of 2,130 feet, and ten groins of brush alone, having a total length of .534 feet, were constructed on the outer extremity of Long Beach. The brush and stone groins were made by placing brush flat on the surface of the beach, and piling upon it beach bowlders to a height of about 18 inches. These groins are about five feet wide. The brush groins were made by digging a trench two feet by two feet, and placing brush in it, upright and as close as practicable, the brush being held by sand thrown into the trench, and well rammed down, and sometimes further protected by small bowlders placed in a row along the sides of the groin. The brush rises about two or three feet above the surface of the beach. These groins are located as follows:—

Eleven brush and stone groins and three brush groins on the outside of the breakwater, perpendicular to it, and in the first 800 feet from the beacon; six brush and stone groins and six brush groins on the outside of the plank bulkhead, perpendicular to it, and along a distance of 300 feet, commencing at a point about 1,800 feet from the beacon; one brush and stone groin at the beacon, on the inside of the bulkhead, and perpendicular to it; one on the inside of, and nearly parallel to, the plank bulkhead, 440 feet long, commencing about 400 feet from the beacon; and one brush groin fills an interval in the plank bulkhead about 1,700 feet from the beacon. In constructing these groins, 1,165 tons of small bowlders were used.

In addition to this, over 10,000 hills of beach-grass have been planted, and repairs have been made, where necessary, upon the bulkhead and jettées on Long Beach.

Amount available, as above, July 1, 1873,	\$4,288 85
Amount expended during the six months ending December 31, 1873,	2,872 73
Amount available for additional work,	<u>\$1,416 12</u>

VII.—IMPROVEMENT OF WELLFLEET HARBOR, MASSACHUSETTS.

By an Act of Congress approved June 10, 1872, the sum of \$5,000 was appropriated for the removal of *rocks* at entrance of this harbor, and a contract was made, August 23, 1872, with Mr. Samuel Dyer, of Truro, Mass., the lowest bidder, for the removal of the following-named sunken rocks, which had been found by a special survey to be the most dangerous obstacles to navigation, viz.:—

1. *Channel Rock*—situated about 2,000 yards to the south-east of Billingsgate Light, and lying in about $12\frac{1}{2}$ feet of water, with only two feet of water over it at mean low water ;

2. *Lobster Rock*—situated in mid-channel, about 1,400 yards to the eastward of Billingsgate Light, and lying in about 18 feet of water at mean low water, with only $4\frac{1}{2}$ feet of water over it at mean low water ;

3. *Lumpfish Rock*—situated about 500 yards to the north-east of Lobster Rock, with $3\frac{1}{2}$ feet of water over it at mean low water ;

4. *Mayo's Rock*—situated in mid-channel, 40 feet west of Buoy No. 7, and lying in eight feet of water, with $2\frac{7}{10}$ feet of water over it at mean low water ;

5. *Bay Rock*—situated about 700 yards to the north-west of Mayo's Rock, and lying in six feet of water, and awash, at mean low water.

On the 14th of May, 1873, work, which had been suspended during the winter, was resumed upon the removal of these rocks ; and up to the first of July, the following had been done, viz.:—

1. Channel Rock, completed ;
2. Mayo's Rock, completed ;
3. Bay Rock, nearly completed ;
4. Lobster Rock, commenced ;
5. Lumpfish Rock, commenced.

These operations were continued up to the latter part of July, when the removal of all the rocks contracted for was completed.

In addition to which other sunken rocks, not provided for by the contract, were removed by hired labor ; one, lying about 70 feet from Channel Rock, and nearer the mid-channel, and others near Bay Rock—altogether about 50 cubic yards.

Balance of appropriation available July 1, 1873,	.	\$4,179	69
Amount expended since July 1, 1873,	.	4,179	69

whereby all the work projected under the appropriation of June 10, 1872, has been satisfactorily completed.

VIII.—IMPROVEMENT OF PROVINCETOWN HARBOR, MASSACHUSETTS.

Under the several appropriations heretofore made for the preservation and improvement of this harbor, the following work had been done on the first of July, 1873, viz.:—

1. Bulkheads and jettées of various descriptions had been built, from time to time, along Beach Point, for its preservation and protection, both by the United States Government and by the local authorities ;

2. A dike was built, in 1868 and 1869, by the State of Massachusetts, across the outlet of East Harbor Creek ;

3. A dike was built, in 1868 and 1869, by the United States Government, across East Harbor Creek, at the Wading Place, near High Head, about two miles above the outlet of the creek ;

4. Wooden bulkheads and jettées had been built, at different times, for the protection and preservation of the beach on Long Point.

5. A stone bulkhead had been commenced for the protection and preservation of the outer end of Long Point, opposite the lighthouse and the three-gun battery ;

6. A substantial dike (272 feet in length) was built, in 1871–72, across the head of Lancey's Harbor, near Abel Hill ;

7. Beach-grass planted on Beach Point, Long Point, Abel Hill, Cove Section, and Oblique Section ; and at the last two places, brush had also been laid for their further protection ;

8. The projected extension of the several jettées on Beach Point and State dike had been nearly completed ; and

9. Accurate re-surveys had been made (in 1871, 1872 and 1873) of Cove Section, Oblique Section, Beach Point and Long Point, together with elaborate soundings and current observations in the inner harbor.

Amount available July 1, 1873, for the continued
preservation of this work, was \$2,386 62

These operations were prosecuted, with hired labor, until the first of August, when they were suspended until the first of December, and were then resumed and continued until the close of the year.

On the first of August, all the work had been completed for the projected extension of all the jettées on Beach Point and State dike, which, since the first of April, 1873, consisted of 616 linear feet of crib-work jettées, filled with brush and stone, and 636 linear feet of brush and stone groins, connecting the outer ends of the jettées.

In addition to which, the bulkhead and jettées on Beach Point

and the State dike had been repaired, and beach-grass planted, where necessary; and the stone bulkhead on Long Point rebuilt and strengthened at its outer end.

On resuming operations, on the first of December, 1873, the work was confined exclusively to the protection and preservation of the beach at Cove Section, which had been seriously weakened and endangered by the extraordinary gale of November 16th–18th, by which storm the crest-line of the shore was, for an extent of about 200 feet, carried thirty feet inwards, and lowered about three feet, it being now, at this place, only about ten feet above the plane of ordinary high water. This permitted some of the waves during the gale to wash over the crest into the low land in its rear, to a recurrence of which it will hereafter be exposed. With a view to preserving and strengthening this shore, steps were at once taken for building, inside the crest, a crib-work bulkhead, filled with brush and stone, together with several rows of brush groins, in rear of and parallel to it. This work has been prosecuted nearly to completion.

Amount expended for this harbor during the six

months ending December 31, 1873,	.	.	.	\$1,313 74
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Amount available January 1, 1874,	1,072 88
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AN ACT

TO CHANGE A PORTION OF THE HARBOR-LINE IN GLOUCESTER HARBOR.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECT. 1. So much of the one hundred and twenty-fourth chapter of the acts of the year eighteen hundred and sixty-six as establishes a harbor-line beyond which, in Gloucester, no wharf, pier or other structure shall ever hereafter be extended into or over tide-waters in the harbor of Gloucester from a point in the line established by said act, one hundred and sixty-eight feet distant north-easterly from the north-east corner of the then existing stone bulkhead of a wharf then of J. Low, jr., and extending to the south-east corner of a wharf then of S. W. Brown, is hereby repealed; and in place of such portion of said harbor-line, a harbor-line is hereby established, beginning at said point in the line established by said act of the year eighteen hundred and sixty-six, distant one hundred and sixty-eight feet north-easterly from the north-east corner of said stone bulkhead, and running thence in a straight line north-easterly to the south-easterly corner of the westerly wharf of John Pew; thence in a straight line north-easterly to a point ten feet southerly from the south-easterly corner of the middle wharf of said Pew, and formerly of Charles Friend & Co.; thence in a straight line north-easterly to the south-easterly corner of the present easterly wharf of said Pew; thence in a straight line north-easterly to the south-easterly corner of said wharf now or formerly of S. W. Brown: beyond said last described line hereby established, no wharf, pier or other structure shall ever hereafter be extended into or over tide-waters in said harbor of Gloucester.

SECT. 2. The fourth and fifth sections of the one hundred and twenty-fourth chapter of the acts of the year eighteen hundred and sixty-six shall apply to this act.

SECT. 3. This act shall take effect on its passage.

NINTH ANNUAL REPORT

OF THE

BOARD OF HARBOR COMMISSIONERS.

JANUARY, 1875.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
79 MILK STREET (CORNER OF FEDERAL).
1875.

R E P O R T.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor Commissioners respectfully submit their Ninth Annual Report.

SOUTH BOSTON FLATS.

In submitting its last Annual Report, the Board announced that the negotiations with the Boston-Wharf Company, the Boston & Albany Railroad Company and the city of Boston, of terms of coöperation in the improvement of the South Boston flats were complete and had been consummated; and made an historical statement, quite in detail, of the objects, actions and negotiations connected with this great measure of harbor improvement, up to the date of their report.

During the past year the duties of the Board, in connection with this matter, has been mainly confined to action bearing upon the practical work of carrying out the projected improvement.

Satisfactory progress has been made in the construction of the sea-walls inclosing that part of the flats which the Commonwealth has undertaken to improve, viz., the twenty-five acres lying at the north-westerly corner of the flats and bordering upon Fort-Point Channel and the main channel of the inner harbor.

Particular regard has been paid to the *quality* of the work. These sea-walls are to be retaining-walls for solid filling, upon which heavy superstructures may be built and heavy material stored; and, as they also serve the purpose of wharf-faces, bordering upon deep channel-ways, which vessels of the largest class can approach and where they can land their cargoes, it is important that not only the plan of the structure itself, but the manner of its construction, should be of the

first class. The execution of this work, according to the plans adopted by this Board, so far as it has progressed, under the able supervision of Edward S. Philbrick, Esq., is deserving of special notice. The Board is gratified to state, that the light sea-wall, now completed along the border of the Fort-Point Channel, is equal, if not superior, to any other structure of its kind in the waters of the Commonwealth. And no work, to their knowledge, has been undertaken, in any harbor of our country, superior in its design or workmanship to the plan and execution of the heavy sea-wall, so far as it has progressed.

About 160,000 cubic yards of material have been dredged, partly from the trenches of the sea-walls and partly from the flats outside of them. This material has been deposited as filling upon the twenty-five acres of territory within the sea-walls before alluded to,—serving, as contemplated in the general plan, the double purpose of utilizing the flats and deepening the harbor.

. In order to afford access to the ground of work, so that the stone-vessels might discharge their supplies in place, without delay, or regard to the particular stage of tide, and also as a measure of systematic progress, the dredging—after the trenches were first dug—has been so executed as to give a channel-way along the outer line of the sea-walls, with "cuts" through the flats, somewhat tangent to the circular portion of the sea-wall,—one cut leading into the deep water of Fort-Point Channel and one into the deep water of the main channel of the inner harbor.

The set of the tide in this passage-way, through what was before shallow flats, gives evidence of the accuracy of the determination of the line of flowage with which the precise location and trend of the sea-wall was intended to coincide.

The amount of dredging still to be done, in order to complete the filling of the twenty-five acres enclosed by the sea-walls,—reserving a space for a dock,—is estimated by Mr. Philbrick at about 435,700 cubic yards.

After preparing the pile foundation, the masonry-work of the light sea-wall was begun, in March, 1874, and has been successfully completed. This wall extends from the boundary of the flats belonging to the Boston-Wharf Company to the junction with the heavy sea-wall, and is 641 feet in length.

In April, 1874, work was begun upon the heavy sea-wall. Most of the rubble foundation has been laid from the end of the light sea-wall to the proposed dock,—being about 765 feet in length and containing about 12,000 cubic yards of material.

In September the work of laying the cut-stone for the wall proper was commenced, and is still in progress. About 1,105 yards of this masonry has already been laid, mostly in the lower courses.

The estimated value of work already done is	.	.	\$155,000 00
Value of work yet to be done,	.	.	445,095 00
<hr/>			
Total cost of work when finished,	.	.	\$600,095 00

A report to the Board by Mr. Philbrick is appended, together with a sketch showing the location of the work, the extent and position of the light and heavy sea-walls, and of the area of flats which have been dredged away, indicated by the shaded cross-lines, with the general depth of water attained, shown by the figures within these shaded lines.

EASTERN-AVENUE BRIDGE.

It has been the steady policy and persistent effort of the Board to improve the navigation and provide the greatest practicable maritime facilities for Boston harbor. To this end, it has given its closest attention and best judgment, and brought its best knowledge and experience to every work which has come before it for consideration and action, and has asked for legislation to support it where cases have required it.

When the time came in the development of the South Boston flats improvement to build a bridge in the line of Eastern Avenue, the Board had hope that, in thus connecting the territory of the Commonwealth with the commercial centre of its capital, one example might be given of a structure which should have the best features of public advantage; and as no parties were so much interested in the question as the city and the State, that the subject would be treated on the broadest basis of public utility and comprehensive foresight. The Board, as representatives of the State, and the city, through its Street

Committee and Engineers, were in harmony as to the best plan of bridge practicable to build, when official action on the part of the Board in relation to this matter was interrupted by counter-action from other parties.

The following documents and correspondence explain the case and the position of the Board in regard to it:—

COMMONWEALTH OF MASSACHUSETTS.

HARBOR COMMISSIONERS' OFFICE,
8 PEMBERTON SQUARE, BOSTON, October 19, 1874. }

To the Honorable Committee on the Streets of the City of Boston:

GENTLEMEN:—The Board of Harbor Commissioners has received from the Joint Committee of the City of Boston on Streets, a copy of the following vote:—

"IN JOINT COMMITTEE OF THE CITY COUNCIL ON STREETS, }
October 10, 1874. }

Whereas, The present grade of Eastern-Avenue Bridge was established by the City of Boston upon the recommendation of the representatives of the State; and

Whereas, The city is now urged by other representatives of the State, and by other parties in interest to reduce the grade; and

Whereas, The owners of property in the South Boston flats are the parties mainly interested in securing any change in the grade as at present established; therefore

Voted, That if it appears that the representatives of the State and the other parties interested desire a reduction of the grade, and the city will be fully indemnified for any expenses growing out of the same, this Committee will recommend the City Council to reduce the grade to twenty-one feet above mean low water at the centre of the draw."

The Board has received from the Secretary of the Commonwealth a copy of the following order of the Governor and Council:—

COMMONWEALTH OF MASSACHUSETTS.

COUNCIL CHAMBER, }
BOSTON, October 15, 1874. }

In Council: *Ordered*, That the Council recommend to the Harbor Commissioners to arrange with the City of Boston to change the grade of the bridge in Eastern Avenue, over Fort-Point Channel, from twenty-six feet to twenty-one feet above mean low water, providing the alteration can be made without expense to the State.

Order adopted October 15, 1874.

OLIVER WARNER, *Secretary*.

SECRETARY'S DEPARTMENT, October, 16, 1874.

A true copy.

OLIVER WARNER, *Secretary of the Commonwealth*.

In view of such action, this Board submits a brief statement of the principal considerations that have governed its past course and will determine its future action in relation to the grade of Eastern-Avenue Bridge. This bridge is to be built over a navigable stream, teeming with vessels passing to and fro, and flowing through a populous commercial city. Two lines of traffic must cross each other's path: the one by the bridge, and the other by water. One must wait for the other, if both are to be maintained, and the adjustment of these conflicting interests to be secured by reducing as much as possible the delays caused by the passage of vessels through the draw across the line of the highway. The delay is caused by the opening and shutting of the draw and by the passage of the vessel through.

Relief, then, must come from increasing the rapidity of the movement of the draw, and of the vessel passing through it. Rapidity of movement in the draw may be secured by making it narrow and light, and giving it a perfect poise, as is done in Chicago.

When the draws are made wide and ponderous, steam may be applied, and this is the method last employed in Boston. Increased speed in passing a vessel through the draw is secured by applying the power of a steam-tug. If, however, the draw must be opened for the steam-tug on its return passage without a vessel, all the saving that is made by the rapid passage of a vessel through the draw is lost by the increased number of times the draw must be opened for the passage of tugs. To retain this saving, the draw must be so built that the tug, by lowering its smoke-stack, can pass under it when closed, at all stages of the tide. This is the system which the city of Chicago has had the intelligence to apply to Chicago River. Twenty-seven streets are carried over this river, some of them in the heart of the city, and the whole detention to travel over these bridges, by the passage of a vessel, has been reduced to a period varying from one-half minute to a minute and a half. There, no vessel is allowed to pass a draw without a tug, and no draw is opened for a tug alone.

The draw in Eastern-Avenue Bridge, it is safe to estimate, will be opened fifteen thousand times a year,—say an average of fifty times every day, not reckoning Sundays. Five minutes is the average detention on the bridge with the best draws in Boston, when the vessel drifts through stem foremost on the tide, or is hauled through by hand. Consequently, the delays of traffic over this bridge, caused by vessels passing through this draw, would amount to five hours daily, unless the rapidity of the passage of the vessel through the draw is in some way accelerated, and the steam-tug is the only appliance which it has thus far been

found possible to use for this purpose. The lowering of the grade to this bridge has seemed to the Board to involve the perpetuation of this evil. It cannot be predicted what will be the amount of traffic that will pass over this bridge. If the amount for a single day over the Federal-Street Bridge four years ago is any criterion, that was represented by five thousand eight hundred and sixty teams, and seventeen thousand eight hundred and seventy-three foot passengers, not to mention seven hundred and sixty-three horse-cars with their thirteen thousand passengers.

So great and exasperating a grievance were these delays at bridges over Fort-Point Channel felt by the people of South Boston to be, that their representative in the State Senate, in the year 1871, introduced in the legislature an order of inquiry contemplating the shutting up of all the draws on Fort-Point Channel, and stopping all the navigation of this channel and South Bay.

The violence of such a measure will be appreciated when it is considered that the extinction of Fort-Point Channel and South Bay amounts to the destruction of a water-front in the midst of the city, three and a quarter miles in linear extent, of over four millions square feet of wharf property in actual use, to which are annually brought cargoes representing a value of over twenty million dollars, and the loss of navigable waters over which some ten thousand vessels, of every variety of tonnage, from nine hundred tons down, annually pass. This Board earnestly resisted the measure.

The joint committee of the legislature on harbors, to which this order of inquiry was referred, reported against the closing of these draws, or applying to Congress for authority to do so. In its report on the subject, the committee use the following language: "The order, however, did not contemplate immediate action, but rather first to obtain the consent of Congress, and act under it when the proper time arrived; in the meantime *bridging the streams* (i.e., Charles River and Fort-Point Channel), on *some comprehensive plan of ELEVATED STRUCTURES*, and experimenting with tunnel and other plans. The existing structures are too low at high tide to allow the passage of even a scow or barge; so 'lightering' is quite out of the question." While it remains possible to find a remedy in any other manner, the commerce of the streams should not be disturbed. *Elevated bridges*, basin-draws, tunnels, and other improvements, have been projected and successfully used elsewhere. "It should seem that ingenuity has not yet been overtasked or exhausted here."

The committee reported a Resolve instructing this Board "to consider what relief can be provided for the traffic across said river and channel by a system of *improved bridges, the use of steam in moving vessels and draws*, or by any other means, and report to the next

general court, with plans and estimates"; and this Resolve was passed by the legislature. It is remarked that the chairman of the committee who made this report in favor of "a comprehensive plan of elevated bridges" over Fort-Point Channel and Charles River, was the senator from South Boston who introduced the order looking to the permanent closure of the draws over those channels, and might well be supposed to represent the judgment of the people of South Boston in respect to the remedy of this grievance; and, further, that an eminent civil engineer and constructor of bridges, Mr. Parker, of Lancaster, was a member of this able committee.

This Board reached the same conclusion, that "a comprehensive plan of elevated bridges," which would allow the passage of steam-tugs under them when closed, was one of the necessary measures for remedying the evils complained of, and so reported in its Sixth Annual Report to the legislature. It recommended, also, that, when such bridges are built, vessels should not be allowed to pass through them without a steam-tug, and that the draw should not be opened for the passage of a tug merely. So far as the Board has information, these remedies were accepted by all parties as satisfactory. It has ever since been the purpose of the Board to apply them as opportunity offered, believing that such a policy had received the sanction of the legislature and the public.

Accordingly, when the grade of Eastern-Avenue Bridge was under discussion in the city government, this Board urged upon the city of Boston the considerations which led it, in its Sixth Annual Report, to recommend a high grade for all future bridges to be built over Fort-Point Channel; and grade twenty-six was voluntarily adopted by the city government for the surface of the draw.

The slope on each side makes the hardly appreciable grade of fourteen inches in a hundred feet, and seemed to the Board entirely unobjectionable; while the fact that such a grade to the bridge would make it necessary for the Boston-Wharf Company to be at some expense in adjusting the grade of its territory to the high grade of its bridge, did not seem a sufficient reason for surrendering the public advantage to be secured by beginning a "comprehensive plan of elevated bridges," in connection with the regulations for the navigation of the channel already indicated. But, on a reconsideration of this subject by the governor and council, since their approval of the present grade of Eastern Avenue, it appears, from their order already communicated, that these views of the Board have not been reaffirmed by them.

In a case of this character, involving merely a question of public policy, the Board consider that a proper deference to the authority

of its official superiors requires that it should yield to the order of the governor and council, according to its terms.

The Board, therefore, notify the city committee that, in case the city of Boston shall see fit to submit to this Board, plans for the construction of Eastern-Avenue Bridge, at grade twenty-one instead of grade twenty-six for the surface of the draw, this Board will—subject, however, to the approval of the governor and council—sanction the plans and authorize the structure.

Should the city committee be of opinion that it is desirable to change the grade of Eastern Avenue, this Board would make one suggestion for its consideration.

The change, if made, will have been made on the application, and largely for the benefit of, the Boston-Wharf Company. This company has always, heretofore, refused to meet the demands of the city of Boston and of the Commonwealth for the right—should the public interest require—to have a street from Northern Avenue to Eastern Avenue, over its territory, between B Street and Fort-Point Channel. When so much consideration is paid to the interests of this corporation, the Board would suggest that this slight concession, sought in vain heretofore, in any satisfactory form, by the city and the State, should now be insisted upon. The Board transmit herewith the reports of the Legislative Committee on Harbors, of the year 1871, in relation to traffic over Fort-Point Channel and South Bay, and the Sixth Annual Report of this Board to the legislature, for the use of the committee.

JOSIAH QUINCY, *Chairman.*

COMMONWEALTH OF MASSACHUSETTS.

COUNCIL CHAMBER, BOSTON, December 28, 1874.

IN COUNCIL: *Whereas*, The Board of Harbor Commissioners, in its communication of November 14, 1874, have submitted to the governor and council, modified plans for the reduction of grade for Eastern-Avenue Bridge from twenty-six feet to twenty-one feet, and have also called our attention to the expediency of requiring the Boston-Wharf Company to consent to the laying out by the Commonwealth, or city of Boston, of a street of convenient width, from Northern Avenue to Eastern Avenue, over the territory of said company, without compensation for the land so appropriated; and

Whereas, The joint committee on streets of the city of Boston, have sent a communication to the governor and council, dated December 17, 1874, approving the modified plans reducing the grade, as soon as the Boston-Wharf Company will give a bond

or obligation to indemnify the city for all damages and expenses on account of said reduction of grade :

It is ordered, That said modified plans be approved, upon condition that the Boston-Wharf Company consent to the laying out by the Commonwealth, or the city of Boston, of a street of convenient width, from Northern Avenue to Eastern Avenue, over the territory of said company, without compensation for the land so appropriated. And also upon condition that the Boston-Wharf Company shall give bonds to the State of Massachusetts, through its harbor commissioners, and to the city of Boston, to indemnify each of them for all damages and expenses on account of said bridge, or the reduction of the grade thereof.

Order adopted December 28, 1874.

OLIVER WARNER, *Secretary*.

SECRETARY'S DEPARTMENT, BOSTON, December 29, 1874.

A true copy. Attest,

OLIVER WARNER,
Secretary of the Commonwealth.

COMMONWEALTH OF MASSACHUSETTS.

COUNCIL CHAMBER, BOSTON, January 5, 1875.

IN COUNCIL: *Whereas*, A communication has been received from the joint committee on streets of the city of Boston, dated January 1, 1875, informing the governor and council that the Boston-Wharf Company have given satisfactory assurances that the city will be indemnified for all damages on account of the grade of Eastern-Avenue Bridge, and that the city engineer is authorized to order the work to proceed as soon as the modified plans have been approved by the state authorities ; and

Whereas, A hearing was granted upon the request of the Boston-Wharf Company on the 4th instant, to which the harbor commissioners and the joint committee on the streets of the city of Boston were invited ; the Boston-Wharf Company desired to be relieved from the conditions contained in the order of the governor and council of December 28, 1874, concerning the laying out of a street between Northern Avenue and Eastern Avenue, without compensation for land so appropriated.

It appeared that the proposed street would not be needed at present, and the city of Boston making no request in regard to it,

It is ordered, That the conditions contained in the order of December 28, 1874, concerning the appropriation of land for streets, without compensation, be cancelled ;

And it is also ordered, That in consideration of the communication from the joint committee on streets of the city of Boston, dated January 1, 1875, above mentioned, it is also ordered that the condition relating to the bond to the city of Boston, be cancelled, and it is now ordered, that the said modified plans be approved, upon condition that the Boston-Wharf Company execute an agreement to save the Commonwealth harmless from all damages on account of Eastern-Avenue Bridge, or the reduction of the grade thereof; said agreement to be satisfactory to the attorney-general.

Orders adopted January 5, 1875.

OLIVER WARNER, *Secretary.*

SECRETARY'S DEPARTMENT, January 6, 1875.

A true copy.

OLIVER WARNER.
Secretary of the Commonwealth.

COMMONWEALTH OF MASSACHUSETTS.

HARBOR COMMISSIONERS' OFFICE, }
8 PEMBERTON SQUARE, BOSTON. }

Whereas, By license of this Board, dated April 15th, 1874, the city of Boston was authorized to build Eastern-Avenue Bridge across Fort-Point Channel at a grade of twenty-six (26) feet above mean low water at the surface of the draw; and, subsequently, the city of Boston submitted to this Board for their approval a modification of said plan of said bridge, as described in the said license of April 15th, 1874, making the grade of the surface of said bridge at the draw twenty-one feet instead of twenty-six feet above mean low water; and *whereas*, the governor and council recommended, October 15th, 1874, to this Board a change of the grade of the bridge, in accordance with said modified plan, and by their further action of January 5th, 1875, communicated to this Board, have indicated that said modified plan, changing the grade of said Eastern-Avenue Bridge to twenty-one feet above mean low water at the surface of the draw, will be approved by them, provided, that the Boston-Wharf Company execute an agreement, to save the Commonwealth harmless from all damages, on account of the reduction of such grade, satisfactory to the attorney-general; and, *whereas*, said agreement satisfactory to the attorney-general has been executed to the Commonwealth:

Now, therefore, the said city of Boston is hereby authorized, subject to the approval of the governor and council, to proceed and construct said Eastern-Avenue Bridge, at a grade of twenty-one feet above mean low water, at the surface of the draw, in conformity to

the foregoing license, and the plan filed in this office, and numbered 249, making the changes in constructing said bridge, that are necessary to be made, on account of the reduction of said grade to twenty-one feet as aforesaid, which are shown in red ink on plan No. 209, approved by this Board, April 15th, 1874.

In witness, whereof, a majority of the Board of Harbor Commissioners have hereto affixed their signatures this eleventh day of January, A. D. 1875.

(Signed.)

JOSIAH QUINCY.
F. W. LINCOLN.
J. N. MARSHALL.
W. T. GRAMMER.
ALBERT MASON.

CHARLES-RIVER BRIDGES.

When the question of widening the draw-way openings in the Charles-River bridges was before the legislature, in its session of 1869, so as to have them conform to the increased size and width of modern vessels, the Board made a very careful study of the subject. The location and alignment of the bridges, the outlines of the channel, and the complicated currents which struggle through them, were made a matter of thorough investigation. With a system of new and wider draws, the question of the location of the draw in each particular bridge was carefully considered.

As the result of this study, the present plan of a straight pathway through the bridges was devised, as giving the best facilities for the rapid and convenient passage of vessels through them, and causing the least detention to the railroad, wagon and foot passenger transit over the railroad and city bridges which the case admitted. In the interest of the railroad transit over the bridges, this line of the passage-way was thrown as far toward the centre of the river and from the Boston shore as the character of the channel and the existence of shoal ground along its northern margin would admit, so as to give the greatest distance practicable between the depots of the various railroads on the Boston side and the draws.

Promptly following the passage of the Acts requiring these improvements to be made, the Bridge Commissioners com-

menced operations in widening the passage-ways in Charles River and Warren bridges. The Fitchburg and other railroad companies also took early action in carrying out the requirements of the law. The Boston & Lowell Railroad Company, in September, 1874, commenced to open a new passage-way through their freight-bridge, of the width and in the location prescribed. This company have made a valuable improvement in part of the main bridge, in addition to the changes necessary in building the new draw. This improvement consists in a reconstruction of the pile-piers of the bridge, for a distance of one hundred and sixty-five feet eastward and one hundred and seventy feet westward from the new draw,—the new piers conforming or coinciding with the line of tidal currents. This work is now in process of construction, and will soon be completed.

The Bridge Commissioners have completed the reconstruction of Cragie Bridge, so as to improve the flowage, and have built a new draw. They have also improved the working of the old draw of West-Boston Bridge, and have in contemplation the building of a new and wider draw in this bridge during the coming season. In both of these bridges, steam-power has been applied to move the draws.

The Board is, therefore, happy to announce that, with the opening of navigation and the resumption of the business of the coming spring, this improved channel, or passage-way, though all the bridges, of a width and depth sufficient to admit a larger class of vessels than heretofore engaged in its navigation, will be open, from the waters of the outer harbor to the inner basins of Charles River.

CHARLES-RIVER BASINS.

Important plans for the development and improvement of the basins of Charles River, between Cragie Bridge and Brookline Bridge were brought before the Board for their consideration and action during the past year.

These basins, and the water-front of Cambridge, have shared in the increased demand for maritime facilities which Boston finds it necessary to provide. The improved access to these waters, afforded by the wider and more convenient passage-way to them, has stimulated this development.

Plans for the improvement of the water-front of Cambridge, between Cragie and West Boston bridges, were presented by Messrs. James A. Woodbury, Solomon A. Woods and Fred. Pope, asking for the occupation of a large area of flats, upon some practicable and feasible basis of compensation. Many hearings were given by the Board upon this subject, and a labored and thorough investigation of the questions involved in the measure, instituted.

The magnitude of the proposed scheme may be better understood by a few statistics.

The area of flats intended to be filled, amounted, with ground already filled, to about 2,406,235 square feet, equal to about fifty-five acres. The displacement of tide-water which this filling would occasion, was equal to about 802,078 cubic yards.

The value of these flats, when filled, with the expense of sea-walls, filling, etc., would not be sufficient to induce any private party to make the improvement, if the additional tax of thirty-seven and one-half cents per cubic yard were added to it, as a moneyed compensation for the tide-water which would be displaced.

The case submitted, therefore, brought at once before the Board most important questions, affecting the improvement and development of the harbor, as well as its protection and preservation.

After full consideration of the question of maintaining the tidal reservoir capacity of the basin between Cragie and West Boston bridges, the Board decided that it was not expedient to do so, provided proper and sufficient compensation for such loss of capacity as it might sustain, should be made, as an equivalent for the encroachment. The Board devised and authorized the following plan, for the improvement of these basins of Charles River.

The removal of the shoal immediately above West-Boston Bridge, which obstructs the channel near the draw. The excavation of a channel through the upper basin, between West Boston and Brookline bridges, of sufficient width and depth for the requirements of its navigation. The dredging away of the surface of the flats within this basin, outside of the harbor lines, which lie between the channel and the mill-

dam, and belong to the Commonwealth, so that there shall be a film of water over these shoals, instead of bare flats, so long an objectionable and repulsive feature of the basin, at all stages of the tide. Also the removal of flats in the lower basin, between West Boston and Cragie bridges.

The amount of dredging, required in the fulfilment of this plan, was equal, in cubic yards, to the displacement of tide-water occasioned by the filling.

Thus has been inaugurated during the past year, a large scheme of improvement, of the upper basins of the harbor; not for commercial ends alone, but including sanitary and æsthetic features also.

"JUNCTION SHOAL," OFF CONSTITUTION WHARF, IN BOSTON HARBOR.

The Board, in its report of last year, expressed the opinion that the income of the compensation fund for Boston Harbor, accruing during the year 1874, might be advantageously applied in removing such portions of the shoal off Constitution Wharf as interfere with the manœuvring here of steamers of the largest class, and recommended that the legislature authorize the Board to make such expenditure. This authority was given by the following Act (chap. 304 of the Acts of 1874) :—

Be it enacted, etc., as follows :—

The board of harbor commissioners is authorized to contract for the dredging off a portion of Junction Shoal, in Boston harbor, in the neighborhood of Constitution wharf, in such locality as said board shall designate, to a depth not exceeding twenty-three feet at mean low water; and said board may authorize the use of the material so dredged for filling the Commonwealth's flats at South Boston, at the junction of the main and Fort-Point channels, or elsewhere. The income from the compensation fund for Boston harbor, received during the year eighteen hundred and seventy-four, and the receipts, during such year, from assessments for compensation for tide-water displaced, which would otherwise be paid into the said compensation fund, shall be used to pay for such dredging to an amount not exceeding fifteen thousand dollars, which sum, derived from the sources aforesaid, and no other, may be allowed and paid for such dredging, and the same is hereby appropriated.

No such contract shall be made without the approval of the governor and council. [*Approved June 4, 1874.*]

In the pursuance of this measure the Board made further surveys of the ground in question, and intended during the last summer to have executed the necessary dredging. The season, however, became so far advanced before it was practicable to commence this work, that the Board had doubt concerning its satisfactory completion during favorable weather. It was, therefore, determined to postpone the operation of dredging for the season. The Board intends, at an early date next season, to take measures to have this shoal removed, as proposed.

COMPENSATION FUND FOR BOSTON HARBOR.

The following statement represents the amount of the Compensation Fund for Boston Harbor, with the receipts for the year 1874, as collected from the following named parties, for tide-water displaced :—

Cash on hand, January 1, 1874,	\$88,056 77
Brine & Clark,	\$32 25
Proprietors of Liverpool Wharf,	1,496 62
Boston & Maine R. R. Co.,	129 56
Boston & Maine R. R. Co.,	9 37
Commercial Wharf Corporation,	10 87
Benj. Randall,	4 99
Batchelder Brothers,	1,109 25
Malachi Clark	75 00
	<hr/>
	2,867 91
	<hr/>
	\$90,924 68

LEGAL PROCEEDINGS.

The information by the attorney-general, brought at the relation of this Board, against the Boston & Lowell Railroad Corporation, to restrain it from filling flats in tide-waters of Boston Harbor in Miller's River without authority of the legislature, has been reported for the decision of the full bench of the supreme judicial court, and is still pending.

The decision of this case will settle the legal question whether work begun on flats by an owner merely by virtue of his title to the upland before the passage of chapter 149 of the Acts of 1866, can be continued after the passage of this

Act without authority from the legislature or the Board of Harbor Commissioners. It involves, also, the practical question whether compensation shall be paid for the tide-water of Boston Harbor displaced by such work.

Informations by the attorney-general, at the relation of this Board, have also been brought against the cities of Cambridge and Somerville respectively, to restrain them from filling up the bed of Miller's River between the Boston & Lowell Railroad and Bridge Street, without submitting plans to the Board of Harbor Commissioners for approval. The legal question involved is whether these cities, doing this work under the authority of chapter 304 of the statutes of 1873, were subject to the provisions of chapter 149 of the statutes of 1866. The practical question in these cases, also, is whether compensation shall be paid for the tide-water displaced.

The only mode of enforcing the payment of such compensation in these cases, is to enjoin the work, and so oblige those doing it to obtain the license of the Harbor Commissioners to legalize it. Such a license could not be granted except on the statute of 1866, chapter 149, requiring the payment of compensation for any displacement of tide-water, affecting Boston Harbor.

RESURVEY OF BOSTON HARBOR BY THE U. S. COAST SURVEY.

Pending the changes in the affairs of the Coast Survey, consequent upon the resignation of Prof. Benjamin Peirce from its superintendence, after seven years of distinguished administration, no action has been taken in regard to the communication of the Board, asking the superintendent to "consider the propriety of instituting another series of surveys, covering portions of the upper harbor, and extending it into the lower harbor, as far as he might deem it expedient."

It is the intention of the Board to lay this matter again before Superintendent Carlile P. Patterson, trusting that it will meet with his favorable consideration. The eminent qualifications and physical knowledge of the new superintendent as a hydrographer, will give great value to his counsel and advice in matters relating to the interests of Boston Harbor.

GOVERNMENT WORK BY THE UNITED STATES ENGINEERS IN
BOSTON HARBOR AND ON THE EASTERN COAST OF MASSA-
CHUSETTS.

By the courtesy of General George Thom, of the United States engineers, the Board has received a manuscript report of his works upon the coast of the Commonwealth, which will be found in the Appendix. To that part of it which refers to Boston Harbor, the Board would call particular attention, on account of the announcement, by General Thom, that all of the many sea-walls guarding the shores and headlands of the harbor are now *finished*, and in *good order*. These walls have been in process of construction through many years. Some of the earlier works have been injured, by the action of the storms they were intended to resist, and have required repairs, which have been duly made.

Boston Harbor.

Point Allerton.—The total length of the sea-wall at Point Allerton is 1,202½ feet. This wall was finished in May, 1874. The work done upon it, since General Thom's last report was rendered, has been 227.2 feet of wall, with corresponding excavations, earth-filling and granite paving; besides which, 1,005 linear feet of granite apron, and eight jetties, have been built, as a protection to the foundation of the wall against the action of the storms to which this headland of the harbor is exposed. It is with satisfaction and gratification that we feel able to state that this bulwark of the harbor is now secure.

Great Brewster.—The sea-wall on Great Brewster is 2,800 feet in length, is in good condition, and answers well the purpose intended.

Lovell's Island.—The sea-walls upon Lovell's Island have been recently repaired, and are now in good condition.

Gallop's Island.—The sea-wall upon Gallop's Island is 1,745 feet in length. This wall was completed in 1871, but the violent storms to which it was exposed had laid bare its

foundation, and rendered necessary works for its protection; 1,555 feet of apron, and eight jetties, have been built for this purpose. This work was completed in April, 1874, leaving the wall in good condition.

North end of Long Island.—The sea-wall on this headland is 2,080 feet in length. It was completed in July, 1874; 541.7 feet of wall, with accompanying excavations, earth-filling and granite paving, with 975 feet of stone apron, and ten jetties, have been built since the date of the last report of General Thom.

Deer Island.—There are three walls upon Deer Island, respectively 1,740, 840 and 420 feet in length. These walls have been recently repaired, and are now in good condition.

The Board cannot speak in too high commendation of the able and systematic manner in which the above-mentioned work has been conducted and completed by General Thom.

Narrows Channel.—The intended improvement of this channel in its course between Brewster Spit, Lovell's and Gallop's Islands, is a project for removing the salient points of Brewster Spit and the south-east and south-west points of Lovell's Island, at an estimated cost of \$56,000. Considerable work in the fulfilment of this project has been done under former appropriations. The remaining work, now in progress under the direction of General Thom, is estimated to be completed in June, 1875.

Upper Middle Bar.—For the improvement of this Bar, a project was devised for cutting a channel through it. This channel is to be 23 feet deep at mean low water, 600 feet wide and 2,200 feet long. The amount of excavation made, up to January 1, 1874, was 46,425 cubic yards. Operations were recommenced in April, 1874, since which time, up to January 1, 1875, 39,962 cubic yards of material have been removed. By this work the channel has been opened to a width of 175 feet, with 23 feet of water at mean low water. There is a probability of com-

pleting this work to its projected width of 600 feet at an early date.

Nash's Rock.—This obstruction to navigation is, in fact, a shoal, lying between Brewster Spit and Point Allerton. The removal of the highest part of this shoal, so that there would be not less than 21 feet of water upon it at mean low water, would require the removal of about 200 cubic yards of bowlders, shingle, etc., over an area of about $637\frac{1}{2}$ superficial yards, at a cost of \$5,000. To give 23 feet of water over the whole shoal, would require the removal of about 16,000 cubic yards of the same material from an area of $9\frac{1}{16}$ acres, at a cost greatly disproportionate to the benefit obtained.

Kelly's Rock.—There are still portions of this rock having less than 23 feet of water over it at mean low water. To remove these portions to the required depth, will require the removal of about 80 cubic yards of rock, at a cost of \$5,000.

Sunken Ledge.—This is another obstruction to navigation in the Narrows channel, discovered by Gen. Thom, in 1872. This rock was removed to a depth of 23 feet at mean low water, in September last.

State and Palmyra Rocks.—These rocks are on the southern side of the Lower Middle Bar, and probably belong to the same ledge. Gen. Thom recommends the removal of about 62 cubic yards of this ledge, to a depth of 13 feet at mean low water. This work has been contracted for, and will be done in June, 1875.

Surveys of Sunken Rocks.—Careful surveys have been made in the Narrows channel, but no rocks, other than those already known, have been found. Surveys were made in Broad Sound, east of Great and Little Faun Bar, over an area 1,000 by 500 feet, but no rocks were found having less than 13 feet at mean low water.

The following estimates are made by Gen. Thom for the several works projected for the further improvement of the harbor :—

For the "Narrows channel,"	\$46,000 00
For completing channel through the "Upper Middle,"	162,518 00
For removing Nash's Shoal,	5,000 00
Completing removal of Kelly's Rock,	5,000 00
Removal of State and Palmyra Rocks,	1,500 00
Contingencies,	17,276 06
Total,	<hr/> \$237,294 06
Amount available January 1, 1875,	117,294 06
Additional amount required for completing all the required improvements,	120,000 00

OTHER WORK ON THE COAST OF MASSACHUSETTS.

Merrimac River.

The appropriations for work under this head, by several Acts of Congress, amount to \$110,000.

The work of improvement done under these appropriations, consists in the removal of clay, bowlders, etc., from the Upper and Lower Falls, and Hazeltine Rapids, amounting in all to 13,798.4 cubic yards.

To complete the contemplated improvements there remains only the highest points of some of the ledge at the lower falls to be removed, for which work there are sufficient funds.

In the river, between Newburyport and Haverhill, Gangway Rock, two rocks above Deer Island ledge, rocks at Rocks Bridge and Little Currier Rock, have been removed. Dredging at Currier Shoal has been made and a dike built at Silby's Head.

Newburyport Harbor.

In this harbor South Gangway Rock has been removed, and work commenced on North Gangway Rock. The wreck of the schooner Globe has also been removed.

Gen. Thom estimates for the further improvement of Newburyport Harbor, and the mouth

of the Merrimac, the sum of	\$22,000 00
And for the river, between Newburyport and Haverhill, the sum of	19,000 00
Total,	<hr/> \$41,000 00

Gloucester Harbor.

Ten thousand dollars have been appropriated for improvement in this harbor. With this fund a number of rocks and bowlders have been removed, leaving a balance unexpended of \$686.84.

Salem Harbor.

The estimates for the various improvements proposed for this harbor, Gen. Thom states as \$48,000. The amount actually appropriated by Congress is \$25,000.

Under this appropriation, work was commenced in December last, and was continued throughout the month, by which 9,916 cubic yards of dredging has been done.

Duxbury Harbor.

The appropriations made by Congress for this harbor were \$20,000. The work intended being the improvement of the south channel, which extends from the "Cow Yard," in a north-westerly direction, for about three miles. The lower part of this channel, for about two and a half miles, had a width of not less than 200 feet, and a depth of about $11\frac{1}{2}$ feet at mean low water. The upper part was originally narrow and crooked, having a width of not more than 80 feet. This part of the channel has been straightened, and a width of 200 feet given, with a depth of eight feet at mean low water. This work was completed in May, 1874.

Plymouth Harbor.

During the last five years, Congress has appropriated \$30,500 for the improvement of this harbor.

This work has consisted in the construction of bulkheads, jetties, and groins, and the planting of beach-grass.

Previous to June, 1874, twenty-three groins of brush and stone, giving a total length of 3,000 feet, and ten groins of brush alone, giving a total length of 534 feet, had been built.

Between June and November, 1874, 3,090 feet of brush and stone groins, and 320 feet of brush groins, and 110 feet of bulkhead, have been built, to strengthen the beach where broken through by the storm of November, 1873.

Thirty thousand dollars is estimated as the sum required for the further improvement and preservation of this harbor.

Wellfleet Harbor.

All the sunken rocks have been removed from the entrance of this harbor, and above, to the extent contemplated.

Provincetown Harbor.

This important harbor has been the subject of various projected and executed works of improvement, for many years, and large sums have been appropriated and expended.

During the past year (1874) \$4,817.03 have been expended in protecting and strengthening the outside beach, near the "head of the meadows," which was encroached upon by the gales of November, 1873, and January, 1874, and subsequent gales. Also in increasing the outer end of the stone bulkhead at Long Point. The efficiency of the work upon the outer beach has been most successfully tested by a violent storm, which rushed over the beach and filled the space, in front of the work, to a depth of two or three feet, with sand, adding greatly to its strength.

FLATS AND MARSHES OF EAST HARBOR IN PROVINCETOWN.

The Board stated in its last annual report that the marsh-owners in East-Harbor marshes had refused to settle their claims for damage done to their meadows and marshes by the construction of the state dike across the outlet of East Harbor, for five thousand dollars, the amount first appropriated for this purpose, and to drain the marshes; and that, by reason of such refusal, the Board had taken no further action in the premises.

During the last session of the legislature, however, and after the last report of the Board was made, the East-Harbor parties renewed their claims in hearings before the joint committee on harbors; and the legislature by chapter 34 of the Acts of 1874 passed the following Resolve:—

Resolved, That the board of harbor commissioners is hereby authorized to compromise and settle in behalf of the Commonwealth any demands that seem to the board just, of any persons or corpo-

rations for injuries resulting to meadows, flats and beaches, in Truro and Provincetown, in the county of Barnstable, from the construction by the Commonwealth of a dike across the outlet of East Harbor, or to purchase in behalf of the Commonwealth the fee of said meadows, flats and beaches, or any part of them, and to receive in behalf of the Commonwealth conveyances or releases of the same, or agreements concerning the same: *provided, however*, that such settlements, purchases, conveyances, releases or agreements shall be subject to the approval of the governor and council; and that there shall be allowed and paid out of the treasury of the Commonwealth for the purposes of this resolve a sum not exceeding ten thousand dollars; and the harbor commissioners may, in making any purchase of said meadows, flats and beaches, or, after the same have been conveyed to the Commonwealth, make any agreements concerning future occupation of the same, or concerning any rights or interests of persons or corporations in the same which to said board may seem fit and proper, subject, however, to the approval of the governor and council. [*Approved April 21, 1874.*]

Owing, partly, to the difficulties of adjusting the matter under consideration, and conferring with all the parties in interest concerning it, the Board has, as yet, come to no definite conclusions, and made no definite arrangements. The parties claiming damages have, however, put their affairs in the hands of Hon. George Marston. Through his instrumentality, the Board have confident expectation of making an early agreement, satisfactory to the Commonwealth and all other parties.

EDGARTOWN HARBOR AND COTAMY BEACH.

The Board is sorry to announce the failure of the attempt which was made by Gen G. K. Warren, in the fall of 1873 to reopen the southern outlet of Edgartown Harbor, through Cotamy Beach.

The Board took an active initiatory part in this matter. It was first appealed to by the town of Edgartown in its corporate capacity, for such aid and action as might lead to measures for the protection and preservation of the harbor. After careful consideration of the subject and a visit to and examination of the locality, the Board petitioned the Superintendent of the Coast Survey for information. This call was cordially and promptly responded to by Superintendent Peirce,

who ordered re-surveys, which were made, together with a comprehensive study of the whole subject. The Board also submitted this project to the United States Advisory Council, and received their endorsement of it. The Board further aided in efforts to procure the appropriation of twenty thousand dollars, which was awarded for this work, by memorializing Congress and advocating what it deemed the just and urgent claims of the case. But neither this Board nor those who assisted and advised it were consulted during the entire progress of the engineering work, so that their information is wholly derived from the printed report of Gen. Warren, quotations from the introduction and conclusion of which are given below :—

Introduction.—The improvement designed for the harbor of Edgartown was to be effected by re-opening Cotamy Bay to the ocean by an artificial cut through Cotamy Beach, thus restoring the circulation of the tides in this harbor as it existed prior to the closing of the natural outlet through Cotamy Beach in 1869.

The operations were confined to digging through the beach and through the contiguous shoal in the bay. The work was conducted with care and energy, aided by the most experienced men of this part of our coast whose services we could procure.

The amount of labor expended and material removed were equal to our expectations, and the cut was carried entirely through the shoal and beach.

It was designed to throw it open at the time of a favorable high tide in the bay, but a very feeble tide in the bay occurred at the time we were ready, and the next high tide in the ocean coming with a violent storm broke into the cut. The velocity of the current was very great, as it had a head of at least four feet.

The current rapidly widened the cut, but did not carry the sand out of it, and, on the change of the tide, the ocean-waves closed the opening on that side. Efforts were made afterward to open the cut with the outflow of the bay-tide, but the waves each time closed it up at the period of slack-water. * * * * *

Conclusion.—I cannot find ground at present sufficient to justify an appropriation for making the only opening in the beach which I consider practicable. But unwilling to stand in the way of an object which others have thought so desirable and easy of accomplishment, I respectfully recommend an appropriation of \$22,000, the original estimate, to be paid to any one who will make the improvement desired; letting it by contract to the lowest bidder,

under sufficient guarantee that he will make a proper effort, and receive compensation upon succeeding.

After a careful study of Gen. Warren's report, the Board,—in view of all the circumstances which attended the failure of the enterprise, the stormy weather, and the small tides which resulted from the lateness of the season,—sees no reason for changing or modifying its former opinion, or doubting the practicability of opening the inlet at a more favorable season, and when the relations of the tides are such as to secure a first outflow towards the ocean, and heartily concurs in the recommendation of Gen. Warren, that the work should be done by contract.

GOVERNMENT WORK BY THE UNITED STATES ENGINEERS ON THE SOUTHERN COAST OF MASSACHUSETTS.

Through the kind attention of Gen. A. A. Humphreys, chief of the United States engineers, the Board has received copies from the original plans of the surveys and works along the southern shores of the State, in charge of Gen. G. K. Warren. These copies of the plans and surveys of the engineers are a valuable acquisition to the archives of the Board.

By the courtesy of Gen. Warren, the Board also received, in December last, printed copies of his report upon the works and surveys above referred to. Gen. Warren's report is too voluminous to be transcribed in full to the pages of our own Report. With the following brief notice of his work extracts will be given from his report in the Appendix :

Hyannis Breakwater.—Ten thousand dollars have been expended in repairs of this breakwater. The west end is in good condition, but the remaining parts are reported as unsafe. Gen. Warren estimates further needed repairs at \$15,400.

Wareham Harbor.—Appropriations amounting to \$30,000 have been made for this harbor, of which \$20,000 have been expended in dredging, to the amount of 46,763 cubic yards, through "Quahaug" and the "Upper" bars, by which means

a channel not less than 60 feet wide and nine feet deep at mean low water has been made up to the town. A rock weighing 28 tons has also been removed from the channel. Further work will be needed in order to make the channel 200 feet wide and nine feet deep at mean low water, for which an additional amount of \$10,000 will be required.

Taunton River.—Shoals, known as "Blake's Table Rock" and "Sheep Pen" have been removed, and a cut about 25 feet wide and 600 feet long made through "Chobbet Rock Shoal" to the depth of nine feet at mean low water. Additional work of improvement is recommended, the estimate for which is \$22,000, which can be advantageously expended in one year.

Edgartown Harbor.—By Act of Congress of June 11, 1872, an appropriation of \$20,000 was made for the protection and preservation of this important harbor,—the work contemplated being the restoration of its former southern outlet, by an opening through Cotamy Beach.

Work was commenced, under the direction of Gen. Warren, on July 21, 1873, and continued until October 27, when it was destroyed by the gale of that date. Some slight work was resumed on October 31 and November 6, without results, when the work of opening the beach was abandoned after \$18,624.52 were expended. Gen. Warren proposes the use of the remainder of the appropriation for a survey to "ascertain what the injury has been in the last five years, and whether it is not better to dredge at Edgartown than at Cotamy Beach."

Survey of Wood's Hole Harbor.—This survey has resulted in the recommended improvement of removing rocks interfering with the present steamboat navigation, at a cost of \$5,000. The further sum of \$22,000 is estimated for a more thorough and extensive improvement, which Gen. Warren earnestly recommends for this important passage-way.

Survey of the Harbor of Fall River.—A survey of this harbor has been made, resulting in the recommendation, by Gen. Warren, of improvements which he estimates at \$45,000, —\$10,000 of which have been appropriated by Congress.

PLANS APPROVED

By the Board of Harbor Commissioners during the Year 1874, for the Erection of Structures in or over Tide-water, and Licenses Granted for such Structures.

1. Road Commissioners of the town of Manchester, for the construction of a stone-and-wood bridge across Edward's Creek. Approved January 7, 1874.
2. Old Colony Railroad Company, to widen its bridge over Fort-Point Channel. Approved January 21, 1874.
3. Robert Crosbie, for leave to build a pile-wharf in East Boston. Approved January 28, 1874.
4. James Buffum, for leave to extend his wharf in Lynn Harbor. Approved February 11, 1874.
5. Weetamoe Mills, for leave to construct a wharf in Fall River. Approved February 18, 1874.
6. Old Colony Railroad Company, for leave to widen its wharf in Fort-Point Channel. Approved March 4, 1874.
7. Horace Cousen, for leave to extend his wharf in Charles River, near Brookline Bridge. Approved March 11, 1874.
8. Edward B. Lane, for leave to extend his wharf and fill flats in Salem Harbor. Approved March 18, 1874.
9. Jarvis R. Nickerson and Washington Robbins, for leave to build a wharf in Cotuit. Approved March 18, 1874.
10. N. H. Bearse, for leave to build a wharf in East Bay, Barnstable. Approved March 18, 1874.
11. William R. Clark, for leave to build sea-walls between Foster's Wharves. Approved March 25, 1874.
12. Boston Gas Light Company, for leave to build a sea-wall on Commercial Point. Approved March 25, 1874.
13. Charles A. Ropes, for leave to extend his wharf on piles in Salem Harbor. Approved March 25, 1874.
14. Eastern Railroad Company, for leave to build a bridge across Prison-Point Bay. Approved April 8, 1874.
15. City of Boston, for leave to rebuild the foundation of draw in Broadway Bridge. Approved April 15, 1874.

16. City of Boston, for leave to build Eastern-Avenue Bridge across Fort-Point Channel. Approved April 15, 1874.
17. Fitchburg Railroad Company, for leave to drive piles to support a railroad track scale in its bridge over Charles River. Approved April 22, 1874.
18. The Philadelphia & Reading Coal and Iron Company, for leave to extend its wharf in New Bedford Harbor. Approved April 22, 1874.
19. W. S. Fretch & Company, for leave to deposit dredged material in Salem Harbor. Approved April 29, 1874.
20. F. H. Moulton, for leave to construct a pile-pier in Salem Harbor. Approved May 6, 1874.
21. Alexander Gayland, for leave to build a wharf in Provincetown Harbor. Approved May 6, 1874.
22. City of Boston, for leave to extend the Northerly-Guard Pier on the North Ferry, East Boston. Approved May 13, 1874.
23. Swett & Company, for leave to extend their wharf in Gloucester Harbor. Approved May 20, 1874.
24. City of Boston, for leave to modify the foundation-pier for the draw of Eastern-Avenue Bridge. Approved May 20, 1874.
25. George Bancroft, for leave to construct a bulkhead and wharf in Charles River, Cambridge. Approved May 27, 1874.
26. Allen Reed, for leave to construct a pile-wharf in Provincetown Harbor. Approved June 3, 1874.
27. John K. Hodgdon, for leave to extend his wharf in Chelsea Creek. Approved June 3, 1874.
28. Samuel Knowles, for leave to build a wharf in Provincetown Harbor. Approved June 10, 1874.
29. Dennis & Ayer, for leave to extend their wharf in Gloucester Harbor. Approved June, 1874.
30. Oriental Coal Oil Company, for leave to extend their wharf in Mystic River. Approved June 26, 1874.
31. Walen & Allen, for leave to extend their wharf in Gloucester Harbor. Approved July 3, 1874.
32. Leighton & Company, for leave to extend their wharf in Gloucester Harbor. Approved July 3, 1874.

33. John E. Cassidy, for leave to build a sea-wall in Charles River, Watertown. Approved July 8, 1874.
34. John Pew, for leave to extend his wharf in Gloucester Harbor. Approved July 8, 1874.
35. James A. Woodbury, Solomon A. Woods and Frederick Pope, for leave to fill flats in Charles River, Cambridge, between West Boston and Cragie bridges. Approved July 8, 1874.
36. Pool & Cunningham, for leave to extend their wharf in Gloucester Harbor. Approved July 15, 1874.
37. Boston & Albany Railroad Company, for leave to build docks on its flats in South Boston. Approved July 24, 1874.
38. Benjamin Lancy, for leave to extend his wharf in Provincetown Harbor. Approved August 12, 1874.
39. Choate Burnham, for leave to build sea-walls in Dorchester Bay. Approved August 12, 1874.
40. Boston Gas Light Company, for leave to dredge in Neponset River. Approved August 19, 1874.
41. Fall River Iron-Works Company, for leave to extend its wharves in Fall River. Approved August 26, 1874.
42. Old Colony Railroad Company, for leave to build a bridge over Taunton River, between Fall River and Somerset. Approved August 26, 1874.
43. Boston & Lowell Railroad Corporation, for leave to widen its bridge over Charles River, and building a new draw in its freight-bridge. Approved September 16, 1874.
44. Edmund Durgin, for leave to dredge and fill flats in South Bay. Approved September 30, 1874.
45. City of Boston, for leave to extend Swett Street across South Bay. Approved September 30, 1874.
46. J. R. Bassett, for leave to build a wharf in Charles River, Cambridge. Approved September 30, 1874.
47. Henry L. Batchelder, for leave to extend his wharf in Fort-Point Channel. Approved September 30, 1874.
48. H. Barker & Co., for leave to build a sea-wall in Charles River, Newton. Approved October 8, 1874.

49. Josiah Quincy, for leave to dredge a channel in Quincy Bay. Approved October 29, 1874.
50. Joseph Friend, for leave to extend his wharf in Gloucester Harbor. Approved December 2, 1874.
51. John W. Wheeler, for leave to build a wharf in Goose or Granite Cove, Gloucester. Approved December 9, 1874.
52. Nathaniel Parsons, for leave to build a wharf in Goose or Granite Cove, Gloucester. Approved December 9, 1874.
53. Boston, Revere Beach & Lynn Railroad Company, for leave to construct a bridge over Sales Creek, Revere. Approved December 16, 1874.
54. City of Boston, for leave to rebuild the draw-pier in Broadway Bridge, over Fort-Point Channel. Approved December 16, 1874.
55. David Conwell, for leave to extend his wharf in Provincetown. Approved December 23, 1874.
56. John F. Wonson & Co., for leave to extend their wharf in Gloucester. Approved December 30, 1874.

LEGISLATIVE COMMITTEE HEARINGS.

1874.

- Feb. 26. On the petition of the Mayor of Chelsea, for authority to establish bathing-houses.
26. W. H. Brooks, for leave to extend his wharf in Chelsea.
- Mar. 4. Mayor of Cambridge, for authority to build a bridge across Charles River, from Cambridge to some point on Beacon Street.
5. Mayor of Cambridge, for authority to lay out an Avenue from Brattle Street, Cambridge, to Market Street (Ward 19), Boston.
5. James A. Woodbury and others, for incorporation of the Cambridge Improvement Company.
10. Samuel Knowles, for leave to build a wharf in Provincetown.
10. Boston, Revere Beach & Lynn Railroad Company, for leave to establish a Ferry between Boston and East Boston.

- Mar. 10. Harvey Scudder, for leave to build a wharf in Barnstable.
10. George Dickerman, for leave to build a wharf in in Mattapoisett.
17. Mayor of Cambridge, for authority to build a bridge across Charles River.
17. H. W. Wilson, J. F. Paul and Edward Atkinson and others, for legislation to improve South Bay.

HEARINGS BEFORE THE BOARD.

One hearing on the petition of Jonathan Seavey, in relation to detention of his vessel in the draw of the Boston & Lowell Railroad bridge across Charles River.

One hearing on the petition of the Old Colony Railroad Company, for leave to drive piles along its frontage in Fort-Point Channel.

Three hearings on the petition of Cook, Jordan & Morse, for leave to build wharves in Mill Creek, Neponset River.

One hearing on the petition of Charles A. Ropes, for leave to extend his wharf in Salem.

Three hearings on the petition of R. Murphy, for leave to build a boat-house on piles, north side of Dover-Street bridge.

One hearing on the petition of the Boston Boat Club, for leave to place a boat-house on Charles River at West Boston Bridge.

Three hearings in regard to Eastern-Avenue Bridge across Fort-Point Channel.

Three hearings in regard to a change in the harbor line, between the wharf of Leighton & Co. and the wharf of John Pew & Son, Gloucester Harbor.

Three hearings in regard to bridge built by the Eastern Railroad Company across Prison-Point Bay.

One hearing on the petition of the Philadelphia & Reading Coal and Iron Company, for leave to extend its wharf in New Bedford.

Two hearings with Street Commissioners of the city of Boston, in regard to the extension of Swett Street across South Bay.

Six hearings on the petition of James A. Woodbury, S.

A. Woods and Frederick Pope, for leave to fill flats in Cambridge, between West Boston and Cragie bridges.

Two hearings on the petition of the New Bedford Railroad Company, for leave to fill flats in New Bedford.

Two hearings with Boston & Lowell Railroad Company, in regard to the building of a new draw in its freight-bridge across Charles River.

One hearing on the petition of the Oriental Coal Oil Company, for leave to extend its wharf in Mystic River.

One hearing on the petition of Leighton & Co., for leave to extend their wharf in Gloucester Harbor.

Two hearings on the petition of the Mayor of Cambridge, in regard to the floats on the Boston pier of Cragie Bridge, kept by Cyrus Bruce.

One hearing on the petition of the Old Colony Railroad Company, in regard to a change in the location of its bridge across Taunton River, between the city of Fall River and the town of Somerset.

One hearing with the railroad commissioners, in regard to the proposed bridge across Taunton River, built by the Old Colony Railroad Company.

Four hearings on the petition of Nathaniel Parsons and J. W. Wheeler, for leave to build wharves in Goose or Granite Cove, Gloucester.

One hearing with the Mayors of Cambridge and Somerville, in regard to filling flats in Miller's River, near Boston & Lowell Railroad.

Two hearings on the petition of Winslow Stewart and Co. and others, in regard to filling done by the Boston & Lowell Railroad Company in Mystic River.

Three hearings on the petition of Edmund Durgin, for leave to dredge and fill flats in South Bay.

One hearing on the petition of Henry L. Batchelder, for leave to extend his wharf in Fort-Point Channel.

One hearing on the petition of Roland S. Hart, in relation to illegal filling done by the Boston Land Company in Revere.

One hearing on the petition of Atkins Nickerson and others, of Provincetown, in regard to rights of shore and wharf owners in Provincetown Harbor.

One hearing on the petition of Jenness & Bartlett, in relation to obstructions in the draw-way in bridge across Merri-mac River, between Haverhill and Bradford.

Two hearings on the petition of David G. Allen, for leave to extend his wharf in Gloucester to the commissioners' line.

PLANS AND SURVEYS.

Preparation of Plans for Annual Reports.

Two plans, showing old and proposed new harbor lines in South Bay.

One plan, showing areas of South Boston Flats to be exchanged between the Commonwealth and the Boston & Albany Railroad Company.

Survey of flats in front of city institutions, for the purpose of dumping material dredged from Upper Middle Bar.

Survey in Charles River, for the purpose of wharf extension by H. Cousen, near Brookline Bridge.

Survey in Salem on account of wharf extension by Charles A. Ropes.

One plan, showing the territory of the Boston & Lowell Railroad Company in Miller's River.

Survey on account of establishing a harbor line in Mystic River, south channel.

Survey in New Bedford on account of wharf extension by the Philadelphia and Reading Coal and Iron Company.

Survey in Gloucester, for the purpose of changing the harbor lines.

Survey in Salem for the purpose of determining dumping ground for dredged material.

Survey in Charles River between West Boston and Cragie bridges, on account of the Cambridge Improvement Company, and two plans made of same.

Survey to establish the harbor line on Commercial Point and Mill Creek.

One plan to accompany report of engineer, for the purpose of wharf extension in Mystic River.

Survey and inspection of Hick's Bridge over Westport River.

Survey in Gloucester, for the purpose of wharf extensions by Nathaniel Parsons and J. W. Wheeler.

Survey of Junction Shoal, Boston Harbor, and plan made of same.

The above record indicates an encouraging interest and activity in enterprises of harbor and coast improvement. Notwithstanding the depressed condition of business and money matters, the number of licenses applied for and granted by the Board, and the inquiries for information which have been made, compare favorably with that of former years.

Fifty-six plans for various structures and improvements within the tide-waters of the Commonwealth, have been approved during the last year.

JOSIAH QUINCY,
F. W. LINCOLN,
J. N. MARSHALL,
W. T. GRAMMER,
ALBERT MASON,

Board of Harbor Commissioners.

B O S T O N H A R B O R ¹⁹

11

Line of 12 ft. at low water

Line of 6 ft. at low water

12 G P O I N T

Arch Wharf

COMMONWEALTH
Commissioners

Northern Avenue

BOSTON & ALBANY R. R. CO.

BOSTON WHARF CO

Eastern Avenue

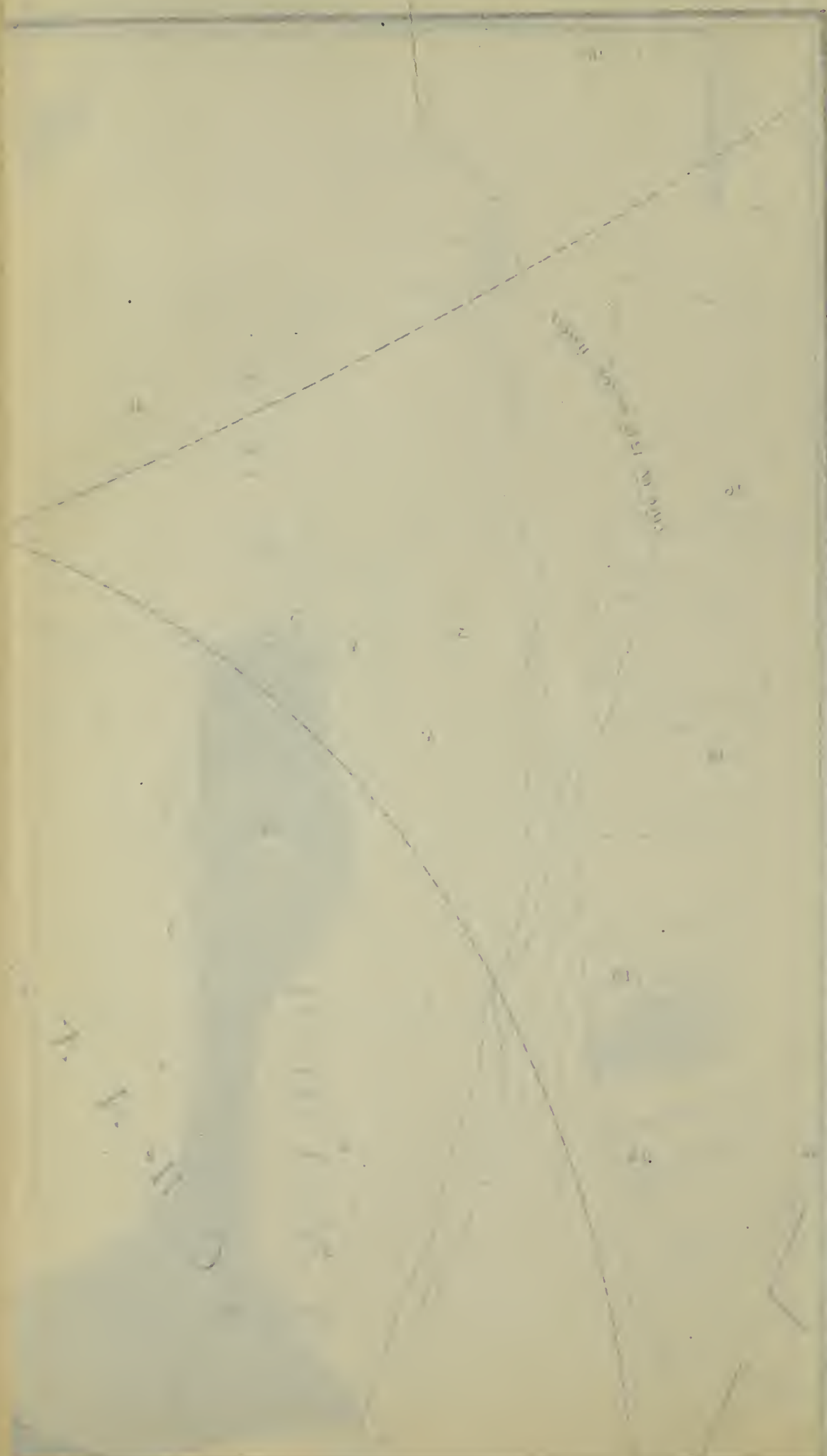
Commissioners Line A

New York & New England R.R.

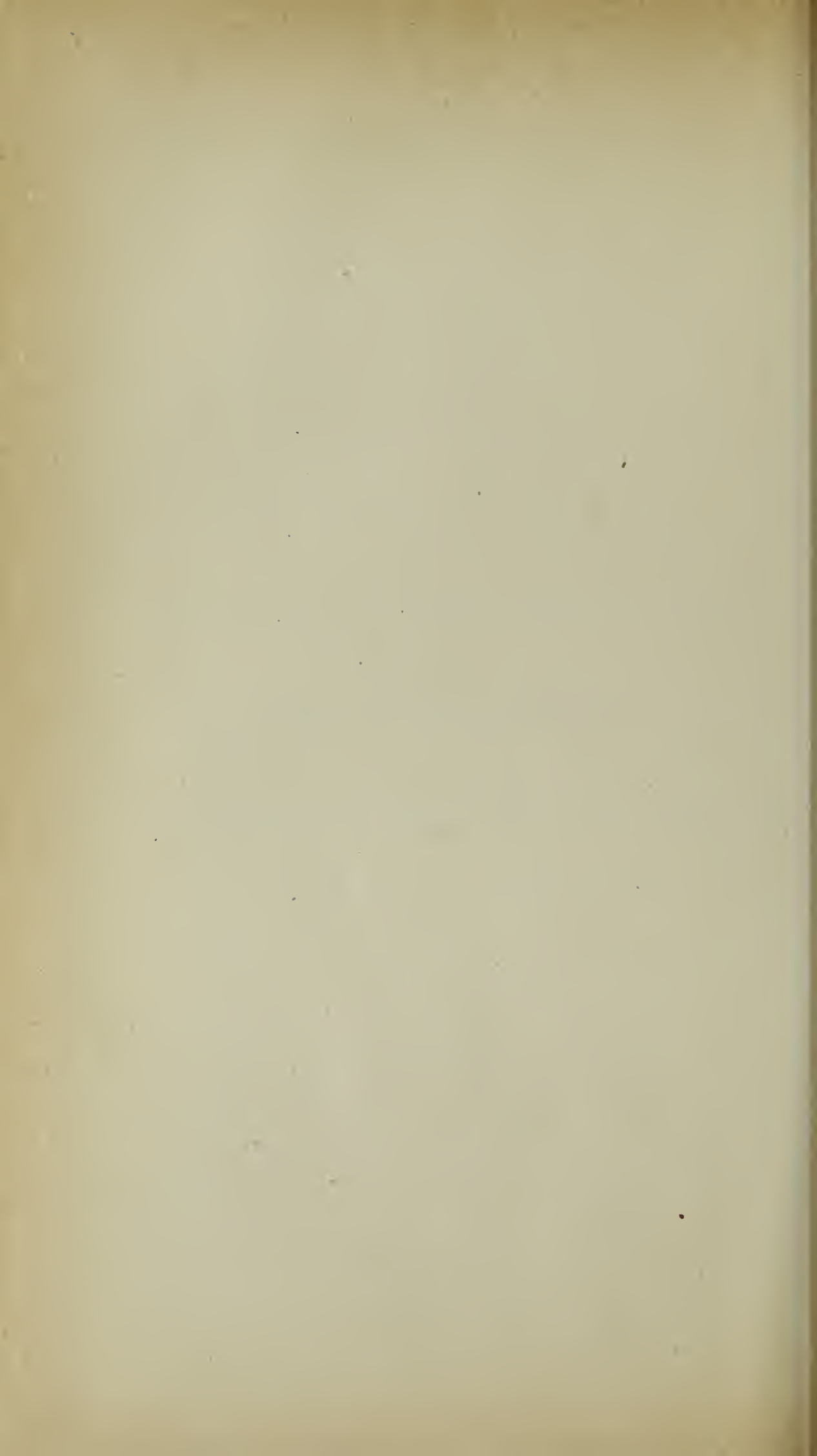
PLAN OF
SOUTH BOSTON FLATS
Showing
LOCATION OF SEA WALLS.
AND
AREA OF EXCAVATIONS.

1874.

Scale, 200 ft. to 1 inch



A P P E N D I X.



APPENDIX.

[A.]

IMPROVEMENT OF SOUTH BOSTON FLATS.

REPORT OF ENGINEER IN CHARGE, DECEMBER 31, 1874.

Work was begun under the contract of Messrs. Clapp and Ballou and the Rockport Granite Company, in October, 1873, by dredging in the location for the heavy sea-wall, the material being deposited for filling the flats of the Commonwealth, to be inclosed by the wall. This work progressed, with some slight interruption, up to September, 1874, when the whole area proposed to be filled had been filled as high as it was practicable to do, by dumping from scows at high water. The contractors have been now, for several months, experimenting upon some apparatus for raising the mud to a higher level, but so far without success; so that the dredging has ceased for some time, after having removed about 160,000 cubic yards. The price to be paid, under the contract for this work, was thirty-nine cents per superficial foot for the ground filled to grade sixteen. The average depth was found to be such as to make this price equivalent to about fifty-eight cents per cubic yard of material.

But as the work hitherto done, by dumping from scows, is much less costly to the contractor, per cubic yard, than the portion to be done hereafter, where the material must be raised higher than the tide will float it, I have not felt justified in estimating the value of the work actually done as over forty-five cents per yard, and my monthly reports for partial payments have accordingly been carried out at the latter rate. The whole amount of filling yet remaining to be done upon the section in progress, reserving a space for a dock, will be about 435,700 cubic yards.

Soon after the beginning of the dredging and filling; viz., in November, 1873, work was begun upon the pile foundation for the light wall along Fort-Point Channel. This was prosecuted, as the weather permitted, during the winter, and the masonry was begun in the latter part of March, 1874, and continued till the completion

of the work, from the boundary of the Boston Wharf Company's flats, for six hundred and forty-one feet, being nearly to the point fixed upon for the beginning of the heavy wall. This structure is now essentially finished, and will, in my opinion, compare favorably with the best work of its class in the country.

In April, 1874, work was begun in depositing rubble for the heavy wall, in the trench which had been dredged for the purpose, and progressed till the present time. We now have the base of this structure nearly finished, from the end of the light wall to the point where the first dock is proposed, say 765 feet in length, containing some 12,000 cubic yards of material. Most of this has already been levelled up by divers, to receive the cut granite. Great care has been taken to insure the compactness of this material. It has received the repeated inspection of divers employed by the State, as well as the occasional personal inspection of a more intelligent kind, through Mr. Joseph O. Osgood, in whose fidelity and thoroughness I have great confidence.

During the month of September, 1864, the work of laying the cut stone for the heavy wall was begun, and is still in progress, when the weather allows.

Some delay was occasioned in beginning this work, arising from its novelty, and the difficulty in having the specifications well understood at the quarries, where the stone should be dressed to the proper shape and dimensions, for no opportunity is had for such dressing after their arrival. The material is brought from Cape Ann by sloops, and laid in places as unloaded by divers, who adjust each stone in its place, while lowered to them by steam-derricks on the sloop's deck. About 1,105 yards of this masonry have been laid, mostly in the lower courses, all the work being still several feet below low water.

Now that the workmen have become familiar with the matter, the progress may be expected to be more rapid, whenever the weather allows; and though it may not be completed as soon as agreed, viz., August 1, 1875, it will perhaps be finished in season to meet commercial demands for its use. The work of completing the heavy wall up to the boundary between the flats of the Commonwealth and those sold to the Boston and Albany Railroad Company, with the filling contemplated, reserving space for one dock, will cost, at rates of present contract, about as shown in the estimate given below, reckoning from the beginning.

Estimate of whole cost of improvement of section of flats between Fort-Point Channel and the flats of the Boston & Albany R. R. Co., exclusive of the dock, for which space is reserved.

885,000 square feet filling, at 39 cents,	\$345,150 00
715 lin. feet light wall, at \$39,	27,885 00
815 lin. feet heavy wall, at \$236,	192,340 00
140 lin. feet heavy wall beyond dock, at \$248, . .	34,720 00
	<hr/>
Total cost when finished,	\$600,095 00
	<hr/>
Value of work to date,	\$155,000 00
Value of work to be done,	\$445,095 00

Respectfully submitted by
Your obedient servant,

EDWARD S. PHILBRICK.

[B.]

UNITED STATES ENGINEERS' OFFICE, }
BOSTON, MASS., January 11, 1875. }HON. JOSIAH QUINCY, *Chairman, Board of Harbor Commissioners, Boston, Mass.*

SIR,—I have the pleasure of furnishing, in compliance with the request contained in your letter of the 31st ultimo, a copy of my report to the Chief of Engineers, on the several works under my charge, for the improvement of harbors and rivers in the State of Massachusetts, for the six months ending December 31, 1874.

Very respectfully,

Your obedient servant,

GEO. THOM,

Lieut.-Col. of Engineers, Bvt. Brig.-Gen. U. S. A.

I. IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

The several works projected and in progress for the improvement and preservation of this harbor, consist of the following, viz.:—

1. The sea-wall for the protection and preservation of Point Allerton ;
2. The sea-wall for the protection and preservation of Great Brewster Island ;
3. The sea-walls for the protection and preservation of Lovell's Island ;
4. The sea-wall for the protection and preservation of Gallop's Island ;
5. The sea-wall for the protection and preservation of the North Head of Long Island ;
6. The sea-wall for the protection and preservation of Deer Island ;
7. Straightening, widening and deepening the main ship-channel in the Narrows ;
 - (a.) At the west end of Great Brewster Bar ;
 - (b.) At the south-east point of Lovell's Island ; and
 - (c.) At the south-west point of Lovell's Island.
8. Widening and deepening the channel through the Upper Middle Bar ;
9. Removal of Nash's Rock ;
10. Completing the removal of Kelly's Rock ;

11. Removal of a sunken ledge situated in "The Narrows," between George's Island and Great Brewster Spit ;
12. Removal of State and Palmyra rocks, on the southern spurs of the Lower Middle ;
13. Surveys of sunken rocks.

1. *Sea-wall on Point Allerton.*—Work was commenced upon this sea-wall, in September, 1870, and was completed in May, 1874, having been built, for the most part, under four separate contracts with Mr. James M. Andrews, of Biddeford, Me., made respectively May 24, 1870, July 26, 1871, August 24, 1872, and May 8, 1873. The last contract provided for completing this sea-wall at the same prices as in previous contracts, viz. :—

1. Granite wall (including granite facing and coping concrete foundation and back-filling), at \$77.90 per linear foot.

2. Concrete for additional foundation, if required, in excess of that called for by the drawings and specifications, at \$11 per cubic yard ;

3. Excavation for foundation, at \$1 per cubic yard ;

4. Back-filling of each, at fifty cents per cubic yard ;

5. Paving (including paving-stones and cobble-stones, shingle and gravel for bedding), at \$6.40 per superficial yard.

The total quantity of work done under this contract in completion of the sea-wall, was as follows, viz. :—

277.2 linear feet of granite wall ;

1,189 $\frac{1}{3}$ cubic yards of excavation for the foundation ;

5,359 $\frac{1}{2}$ cubic yards of earth back-filling ;

1,905 superficial yards of granite paving.

In addition to the above contract work, there have been built since July 1, 1873, for the protection of the concrete foundation of this sea-wall, where most exposed to injury by storms and currents, 1,005 linear feet of granite apron, and eight jetties, in which have been placed 1,598.94 tons of granite grout. This apron has an average width of about ten feet, is from two to three feet in height, and extends all along the fourth, fifth, sixth, seventh and eighth faces, counting from the east, and for about fifty feet along the first face, and along the western wing-wall, in order to protect its junction with the shore crest. The several jetties have a length of twenty-five to thirty feet, a width of about six to eight feet, and a height of two to three feet, and are placed five at the fourth, fifth, sixth, seventh and eighth angles, two from the middle of the first

and seventh faces, and one at the easterly wing-wall. The total length of this sea-wall, as completed, is $1,202\frac{1}{2}$ feet.

2. *Sea-wall on Great Brewster Island.*—This wall, 2,800 feet in length, was built for the protection of the north and south heads of the island, and fully answers the purpose intended. It was commenced in 1849, and was continued through the year 1850, when work upon it was suspended. Since then it has been continued from time to time as appropriations have been made for it. It is now in good condition, not requiring any repairs.

3. *Sea-walls on Lovell's Island.*—There are two sea-walls on this island, one of which was built thirty years ago, for the protection of its north head, and the other in 1867 and 1868, for the protection of the south-east bluff for a length of about 800 feet. These sea-walls have been recently repaired and are now in good condition.

4. *Sea-wall on Gallop's Island.*—This sea-wall is 1,745 feet in length. Work upon it was commenced in the year 1868, and was completed in September, 1871. The violent storms and currents to which this wall is exposed, have laid bare its concrete foundation to such a degree as to have rendered necessary, for its protection and preservation, a stone apron throughout nearly its whole length, with jetties projecting outwards from its faces. This work was commenced in August, 1873, and completed in April, 1874. The apron extends along the base of this wall for a length of 1,655 feet, being on the most exposed faces of the wall, ten feet in width. Eight jetties have been built at and near the angles of the wall, of which five are of split granite, bedded in part in concrete, laid in trenches, and surrounded with a concrete apron, each being eighteen feet in length and five feet in width. The quantity of stone used in this work was about 1,450 tons.

5. *Sea-wall on the North Head of Long Island.*—Work was commenced upon this sea-wall in August, 1870, and has been continued for the most part under contracts with Mr. James Andrews, of Biddeford, Me., made respectively May 24, 1870, July 26, 1871, August 23, 1872, and May 8, 1873; the last of which provided for completing this sea-wall at the same prices as in previous contracts, viz.:—

1. Granite wall (including granite facing and coping, concrete foundation and backing), at \$58.19 per linear foot;

2. Concrete for additional foundation, if required, in excess of

that called for by the drawings and specifications, at \$10.25 per cubic yard;

3. Excavation for the foundation, at \$1 per cubic yard;
4. Back-filling, at fifty cents per cubic yard;
5. Paving (including paving-stones and cobble-stones, shingle and gravel for bedding), at \$5 per superficial yard.

The contractor commenced work under his last contract, in May, 1873, and continued it until its completion, in July, 1874. The work done under the contract of May 8, 1873, was as follows, viz.:

- 541 $\frac{715}{1000}$ linear feet of granite wall;
1,335 $\frac{77}{100}$ cubic yards of excavation for the foundation;
5,617 $\frac{5}{10}$ cubic yards of earth back-filling;
3,391 $\frac{935}{1000}$ superficial yards of granite paving.

The length of this sea-wall is 2,080 feet.

In addition to the above contract work, there have been built since about the first of April, 1874, for the protection of the concrete foundation of this sea-wall where most exposed to injury by storms and currents, about 975 linear feet of stone apron, and ten jetties. This work was completed early in August, 1874.

6. *Sea-walls on Deer Island.*—The three sea-walls on this island were built about thirty-five years ago, for the protection and preservation of the north, middle and south heads, and were respectively 1,740, 840, and 420 feet in length. The injury which these walls had sustained from the violence of the storms was such as to necessitate the rebuilding of them to a great extent. This was commenced in 1865, and completed in 1869. Repairs have recently been made where necessary, so that the walls are now in good condition.

7. *Straightening, Widening and Deepening the main Ship-channel at "The Narrows."*—This work consists in the removal of portions of Brewster Spit and Lovell's Island, so as to obtain a depth of twenty-three feet at mean low water, for a width of 600 feet, with proper slopes up the eighteen-foot curve. Work was commenced on Lovell's Island in 1867, and continued during that and the two following years, until suspended for want of funds. The officer then in charge of this work reported that by these operations the whole south-west point of this island was cut off for a width of 260 feet from the top of the bank in a regular slope to a depth of twenty-three feet at mean low water; and that the channel at that

point had been widened at the depth of the eighteen-foot curve from its former width of 365 feet to 625 feet.

With a view to ascertaining the condition of the channel in "The Narrows" and its vicinity, and what changes, if any, had taken place therein since the completion of the improvements there, including the enlargement of the channel at Lovell's Island, a re-survey of that locality was made, under my direction, in July and August, 1872. This survey showed that the channel at the south-west point of Lovell's Island had not changed to any considerable extent since the dredging operations were closed in 1869; that the eighteen-foot curve was very nearly the same as it was then; and that the shore above low-water line had acquired a more natural slope of eight feet horizontal to one foot rise by the receding inland of the high-water line; also, that the flats off the south-east point of Lovell's Island had advanced so much toward the main channel as to materially impede and endanger navigation. It also showed that the extreme westerly end of Brewster Spit had continued to extend in a westerly or south-westerly direction, the point on low-water line being 120 feet further out than in 1860, and the present eighteen-foot curve 168 feet from that of 1860.

The estimated cost of the improvement of "The Narrows," by the excavation from Lovell's Island to a depth of twenty-three feet at mean low water for a width of 600 feet, with proper slopes inward, and by excavating Brewster's Spit, as contemplated, is as follows, viz. :—

1. Brewster's Spit, 60,000 cubic yards, dredging on westerly extremity of the Spit, at forty cents,	\$24,000 00
2. Lovell's Island, 40,000 cubic yards dredging on south-east point, at forty cents,	16,000 00
3. Lovell's Island, 40,000 cubic yards dredging on south-west point, at forty cents,	16,000 00
Total,	<hr/> \$56,000 00

The improvements projected at the west end of Great Brewster Bar, and at the south-east point of Lovell's Island, have been taken in hand, under the appropriation for this harbor, made by Act of June 23, 1874, for which the following contracts have been made, after advertising for proposals, viz. :—

1. With the New-England Dredging Company, of Boston, for the required dredging at the west end of Great Brewster Bar, at thirty-nine cents per cubic yard,—to be completed June 15, 1875; and
2. With Messrs. Boynton Brothers, of Boston, for the dredging

required on the south-east point of Lovell's Island, at thirty-eight cents per cubic yard,—to be completed June 30, 1875.

The New-England Dredging Company has made very unsatisfactory progress under its contract, having suspended work for the season in the latter part of October, after having done but 4,852 cubic yards of dredging; whilst Messrs. Boynton Brothers have accomplished 11,905 cubic yards of dredging, from their continuing work until the middle of December.

8. *Widening and Deepening the Channel through the "Upper Middle Bar."*—The improvement projected for this bar consists in opening through it a channel to a width of 600 feet, and a depth of twenty-three feet at mean low water, the average length of the "cuts" being 2,200 feet, with an excavation of one to seven feet.

The work done up to the 1st of January, 1874, amounted to the excavation of 46,425 cubic yards, by which an entire "cut" was completed to a width of forty feet, and a length of 8,000 feet; and a second "cut" completed for a length of 1,040 feet, and to a depth of twenty-three feet at mean low water, including the removal of a very large boulder (discovered in the channel in 1872), having but 16½ feet of water on it at mean low water.

On the 27th of January, 1874, proposals were invited for 75,000 cubic yards, more or less, of dredging and rock excavation in continuation of this improvement, and a contract was made for the work on the 5th of March, 1874, with the Atlantic Dredging Company, of Brooklyn, N.Y., which was the lowest of four bidders, at sixty-four cents per cubic yard for excavation of ledge, and boulders exceeding six tons in weight. Operations were commenced under this contract early in April, 1874, and have since been continued, 32,951 cubic yards of dredging having been done up to the 1st of January, 1875, leaving about 42,000 cubic yards still to be done in completion of this contract.

Under the appropriation made by Act of June 23, 1874, for continuing the improvement of this harbor, a contract was made September 1, 1874, with the Harbor Improvement Company, of Boston, for 42,000 to 55,000 cubic yards of additional dredging on this bar, at eighty-five cents per cubic yard, to be completed on or before the 15th of August, 1875. Work was commenced under this contract on the 3d of October, and continued until the middle of December, when it was suspended for the winter, 7,011 cubic yards of dredging having been done under this contract.

By the dredging thus far done on this bar, the projected channel has been opened to a width of about 175 feet, for a depth of not

less than twenty-three feet at mean low water, with a probability of its completion at an early date, for its projected width of 600 feet.

9. *Removal of Nash's Rock.*—Nash's Rock (so called) is a shoal lying in the outer entrance to Boston Harbor, about one-third of the way over from Brewster's Spit to Point Allerton. This shoal was surveyed under my instructions in September and October, 1873, and a special report thereon, accompanied by drawings, was submitted to the Department on the 24th of March, 1874. From information acquired by this survey, it is seen that the only portion of this shoal which it would be advisable and practicable to improve, is that having less than twenty-one feet of water over it at mean low water, which portion has an area of $637\frac{1}{2}$ superficial yards, and would require, in order to obtain a depth of twenty-one feet, the excavation and removal of about two hundred cubic yards of bowlders, shingle, etc., at an estimated cost of \$5,000; whereas, to remove the whole shoal to a depth of twenty-three feet below the plane of mean low water, would require the additional excavation of over 16,000 cubic yards of similar material over an area of $9\frac{1}{16}$ acres, the cost of which would be greatly disproportionate to the benefit that would result therefrom.

10. *Completing the removal of Kelly's Rock.*—This rock lies in the main channel, distant about 700 yards, in a direction south-east by south from the Bug Light (at "The Narrows"), and in the line of entrance-buoy No. 1 and Bug Light. In the autumn of 1869, operations were continued, up to the end of December, 1870. These operations were resumed in June, 1873, and were continued until the 25th of July following, during which time 118 tons of rock were removed. An accurate survey, since made, shows that there is still an area of about 320 superficial yards of this ledge which has less than the projected depth, on the shoalest parts of which there are but 21.2 feet of water at mean low water. In order to obtain the full depth of 23 feet at mean low water, the additional removal of not less than 80 cubic yards will be required, the estimated cost of which is \$5,000.

It is contemplated to have this work completed under the appropriation made for this harbor by Act of June 23, 1874.

Proposals have been twice invited for it, but none have been received which are deemed satisfactory.

11. *Removal of Sunken Ledge, situated in "The Narrows," between George's Island and Great Brewster's Spit.*—This ledge was discovered in September, 1872, in a re-survey of "The Narrows,"

made under my direction. It was situated near the middle of the main ship channel, directly in the track of all large vessels, and particularly of the European steamers, and was distant 317 yards in a direction west by south from Bug Light. It had but $18\frac{9}{10}$ feet of water upon it at mean low water, and was therefore a dangerous obstacle to navigation. Under the appropriation of June 23, 1874, a contract was made August 31, 1874, with Mr. William H. Lloyd, of Boston, for the removal of this ledge, to a depth of 23 feet at mean low water, (altogether $16\frac{1}{8}$ cubic yards), for the sum of \$400, which he completed early in September last.

12. *Removal of State and Palmyra Rocks.* A survey was made of these rocks, under my direction, and in accordance with my project submitted to the department under date of April 2, 1872, of which a special report and drawings were transmitted to the department on the 25th of May, 1874. By this survey it was ascertained that State Rock and Palmyra Rock, of the position and character of which but little previously had been known, are situated very near each other, and most probably are outcroppings of the same ledge, forming spurs on the southern side of the Lower Middle Bar.

To effect the improvement proposed, required, altogether, the removal of about 62 cubic yards of rock, for effecting which, a contract was made August 31, 1874, with Mr. William H. Lloyd, of Boston, who was the lowest of two bidders, at \$1,500—the job to be completed on or before the 30th of June, 1875. This work has already been for the most part completed, with the probability of its entire completion within the time called for by the contract.

13. *Survey of sunken rocks.* The discovery in September, 1872, of an unknown rock in the main ship channel at “The Narrows,” in the vicinity of Lower Corwin and Kelly’s Rocks, created a doubt as to the existence of other unknown rocks in that vicinity. In July, 1873, a careful examination of this channel, was made by dragging for several days between Corwin’s Rock and the north-west point of George’s Island, and by taking a large number of range and random soundings east of Kelly’s Rock, but without discovering any new rocks having less than 23 feet of water over them, at mean low water.

A similar examination has also been made over the shoals east of Great and Little Faun, in Broad Sound, in order to ascertain the locality of certain dangerous rocks, the existence of which has been reported; but after a careful and extended search over an area of 1,000 by 500 feet, which was found to be covered with numerous boulders of various sizes, no rocks were found having less than 13 feet of water over them at mean low water.

The navigation of the north channel is almost always dangerous, and is especially so at low water. To remove all the rock that would be necessary, should the improvement of the navigation of this place be undertaken, would cost much more than would be warranted by the benefit thereby gained.

The following is a recapitulation of the estimated cost of the several works projected for the further improvement of Boston Harbor, viz. :

1. Additional work to be done for straightening, widening and deepening, the main ship channel at "The Narrows," including outstanding obligations on existing contracts, say	\$46,000 00
2. Completing channel through the "Upper Middle,"—	
a. 42,000 cubic yards dredging, at 64 cents, as per contract of March 5, 1874, including percentage retained on work already done, \$32,368 00	
b. 45,000 cubic yards dredging, at 85 cents, as per contract of September 1, 1874, including percentage retained on work already done, 40,900 00	
c. 105,000 cubic yards dredging, not yet provided for, at 85 cents,	89,250 00
	<hr/>
	162,518 00
3. Removal of "Nash's Shoal,"	5,000 00
4. Completing removal of Kelly's Rock,	5,000 00
5. Removal of State and Palmyra Rocks, as contracted for,	1,500 00
Adding for contingencies, say	17,276 06
	<hr/>
Total,	\$237,294 06
Amount available January 1, 1875,	117,294 06

Additional amount required for completing all projected improvements, \$120,000 00

II.—IMPROVEMENT OF MERRIMAC RIVER, INCLUDING THE HARBOR OF NEWBURYPORT, MASSACHUSETTS.

The following appropriations have been made for the improvement of Merrimac River, Mass., viz.:

By Act of July 11, 1870, for improvement of Merrimac River, Mass.,	\$25,000 00
By Act of March 3, 1871, for improvement of Merrimac River, above Haverhill, Mass.,	25,000 00
By Act of June 10, 1872, for improvement of Merrimac River, above Haverhill, Mass.,	25,000 00
By Act of March 3, 1873, for improvement of Merrimac River, Mass.,	25,000 00
By Act of June 23, 1874, for improvement of Merrimac River, Mass.,	10,000 00
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Total,	\$110,000 00

Up to the first of July, 1874, the work was done as follows, viz.:

1. The main (south) Gangway Rock, in Newburyport Harbor, broken up and removed in 1870, to a depth of $9\frac{1}{2}$ feet at mean low water, and a commencement made on North Gangway Rock.

2. The wreck of the schooner Globe removed in 1870.

3. 2,731 cubic yards of clay, bowlders, etc., excavated and removed from the channel of the Lower Falls, above Haverhill, by which the work on these falls was about half completed.

4. The following contracts had also been made under the appropriations of June 10, 1872, and March 3, 1873, with Mr. Augustus R. Wright, of Geneva, N. Y., the lowest bidder, for improving the channel in the Lower Falls, Hazeltine Rapids, and the Upper Falls, viz.:

a. By contract, dated September 9, 1872, for 4,400 cubic yards, more or less, of excavation in the Lower Falls and Hazeltine Rapids, at \$4.95 per cubic yard, under which contract 156 cubic yards of dredging was done in 1873; and,

b. By contract, dated May 30, 1873, for 5,000 cubic yards, more or less, of excavation in the Upper Falls, at \$4.50 per cubic yard; under which contract 3,755 cubic yards of dredging was done in the autumn of 1873. Operations were resumed by Mr. Wright, at the Lower Falls, on the 29th of June, 1874, under his contract of September 9, 1872, and were there continued by him until the 21st of July following, resulting in 1,950.7 cubic yards of dredging, after which he resumed work at the Upper Falls, under his contract of May 30, 1873, which he continued, without interruption, until its completion, in September, 1874, resulting in 3,146.2 cubic yards of dredging,—making altogether 6,901.28 cubic yards done at the Upper Falls. In the latter part of September, after having completed the work at the Upper Falls to the extent proposed, Mr. Wright resumed work at the Lower Falls and at Hazeltine Rapids, which continued until the middle of December, resulting in the completion of all the projected dredging, viz.: 1,619.5 cubic yards; and of 50 cubic yards of ledge excavation, under his contract of September 9, 1872. To complete this work to the full extent contemplated, there remains only the removal of some of the highest points of the ledge at the Lower Falls, for which the funds now available are sufficient.

With this improvement, the channel at Hazeltine Rapids, and at the Lower and Upper Falls, will be navigable for a depth of four feet, in all stages of the river, except in an unusually low stage, which results from shutting off the water, at the Lawrence mills, on Sundays and at night, combined with the low water of spring tides, an event which would seldom interfere with its navigation. The additional

improvements, and the estimated cost of same, projected for this river, at Newburyport, and thence up to Haverhill, Mass., are as follows, viz. :

1.—*Newburyport Harbor at the Mouth of Merrimac River.*

a. Complete removal of North Gangway Rock, 700 cubic yards, at \$20,	\$14,000 00
b. Removing "The Boilers," near the city wharves,	6,000 00
Adding for contingencies, say	2,000 00
Total,	<hr/> \$22,000 00

2.—*River between Newburyport and Haverhill, Massachusetts.*

a. Removal of Gangway Rock, 14 cubic yards at \$20,	\$280 00
b. Removal of two rocks, above Deer Island Bridge, 108 cubic yards, at \$20,	2,160 00
c. Removal of rocks at Rocks Bridge,	1,000 00
d. Removal of Little Currier Rock, 2 cubic yards,	25 00
e. Dredging at Currier Shoal, 6,500 cubic yards at 75 cts.,	4,875 00
f. Dike at Silby's Head, 350 feet, at \$25,	8,750 00
Adding for contingencies, say	1,910 00
Total,	<hr/> \$19,000 00

Total amount required for completing all the projected improvements, as above, being the amount which Congress has been asked to appropriate therefor, is . \$41,000 00

III.—IMPROVEMENT OF GLOUCESTER HARBOR, MASSACHUSETTS.

By an Act of Congress, approved June 10, 1872, the sum of \$10,000 was appropriated for the removal of sunken rocks in this harbor; and with it they have all been removed to the extent contemplated, being as follows, viz. :

1. Clam Rock, removed from a depth of 1 foot to that of $9\frac{1}{2}$ feet below the plane of mean low water, the level of the surrounding bottom.

2. Pinnacle Rocks, removed from $8\frac{1}{2}$ feet above, down to the level of the surrounding bottom, which has a depth of $16\frac{1}{2}$ feet below the plane of mean low water.

3. Rocks off J. Friend's wharf, removed down to the level of the surrounding bottom.

4. Rock off Pew's wharf was entirely removed to a depth of 5 feet below mean low water; and

5. The largest boulders were removed from the rocky shoal known as "Babson's Ledge."

The unexpended balance of the appropriation is \$686.84.

IV. IMPROVEMENT OF SALEM HARBOR, MASSACHUSETTS.

The following is an estimate of the cost of the work projected for the improvement of this harbor, viz.:

1. Excavating a channel 1,730 feet long, 300 feet wide, to a depth of 8 feet at mean low water (giving 17.3 feet at mean high water), from the entrance to South River outward to deep water, including contingencies, . . .	\$25,000 00
2. Constructing a sea-wall and a breakwater for the preservation and protection of Long Point, including contingencies,	23,000 00
Total	<u>\$48,000 00</u>

For this work, the following appropriations have been made by Congress, viz.:

By Act of March 3, 1873,	\$15,000 00
By Act of June 23, 1874,	10,000 00
Total,	<u>\$25,000 00</u>

Under the appropriation of 1873, a contract was made with Mr. Augustus R. Wright, of Geneva, N.Y., for 31,496 cubic yards of dredging, at 44 cents per cubic yard, which he completed in March, 1874; whereby the channel at the entrance to South River was opened to a depth of 8 feet at mean low water, outward to deep water, for an average width of 160 feet. .

Under the appropriation of 1874, a contract was made September 5, 1874, with Messrs. Curtis, Fobes, & Co., of Portland, Me., the lowest of four bidders, for completing all the projected dredging at this place—30,000 cubic yards, more or less,—at the following prices, to wit:

1. Stiff clay intermixed with bowlders, at 35 cents per cubic yard; and,

2. Soft mud, at 20 cents per cubic yard,—both as measured in the scows; the same to be completed on or before the 1st of May, 1875.

Work was commenced, under this contract, on the 9th of December, 1874, and was continued throughout the month; by which 9,916 cubic yards of dredging has been done.

The projected sea-wall and breakwater, for the preservation and protection of Long Point, as estimated, will cost \$23,000, the amount which Congress has been asked to appropriate therefor.

V. IMPROVEMENT OF DUXBURY HARBOR, MASSACHUSETTS.

The following appropriations have been made for the improvement of this harbor, viz. :

By Act of Congress, approved June 10, 1872,	.	.	.	\$10,000 00
By Act of Congress, approved March 3, 1873,	.	.	.	10,000 00
Total, . . . . .	.	.	.	<u>\$20,000 00</u>

This work consisted in the improvement of the South Channel, which extends from the "Cow Yard," so called, up in a north-westerly direction between Captain's Hill and Kingston Flats. This channel, where navigable, is about three miles long; and for a distance of two and a half miles, it had a width of not less than 200 feet, with about $11\frac{1}{2}$ feet of water at mean low water (or about 21 feet at mean high water); whilst for the remaining distance it was narrow and crooked, having a width of not more than 80 feet, for a depth of 8 feet of water at mean low water. The appropriations made as above, have been applied to straightening and widening the upper portion of this channel, so as to have a width of about 200 feet for a depth of 8 feet at mean low water. This work was completed in May, 1874, under the two contracts heretofore reported.

VI. IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

The existence of this harbor depends upon the protection and preservation of Long Beach, which is a narrow strip of land, extending from the main land to the south-east of Plymouth out for about $2\frac{3}{4}$ miles in a north-westerly direction, terminating in a stone beacon. This beach is distant about one mile from the wharves of Plymouth, and affords to the harbor inside of it the only shelter it has from easterly storms. In late years, this beach has been washed away in some places and much weakened in others, to an extent seriously threatening the ruin of the harbor. For the protection and preservation of this beach, various works have from time to time been built, until they have finally been attended with success. During the last five years, the aggregate sum of \$30,500 has been appropriated for this harbor by Congress, including the sum of \$5,000 appropriated by Act of June 23, 1874.

These appropriations have been applied to the construction of bulkheads, jetties and groins, and the planting of beach-grass, where most necessary, for protecting and strengthening this beach. These bulkheads and jetties are built either of stone or of frame-work filled with brush, and ballasted with stone; and the groins, of small stone

intermixed with brush, and sometimes of brush alone. The bulkheads and jetties have accumulated a large quantity of sand, on which beach-grass has been planted throughout mostly its whole extent, thereby forming a high and serviceable backbone. But for the purpose of increasing its strength and permanency at its outer end, parallel groins have been run out perpendicularly to this bulkhead, on the seaward side, varying in length from 75 to 265 feet, whilst others have been placed inside of it, in a way to operate to the best advantage for the purpose in view.

On referring to my last annual report, it will be seen that during the fiscal year ending June 30, 1874, the following work had been done on this beach, viz. :—

Twenty-three groins of brush and stone, having a total length of about 3,000 feet, and ten groins of brush alone, having a total length of 534 feet, were constructed on the outer extremity of Long Beach. The brush and stone groins were made by placing brush flat on the surface of the beach, and piling upon it beach boulders to a height of about eighteen inches. These groins are about five feet wide. The brush groins were made by digging a trench two feet by two feet, and placing brush in it upright and as close as practicable, the brush held by sand being thrown into the trench and well rammed down, and sometimes further protected by small boulders placed in a row along the sides of the groin. The brush rises about two or three feet above the surface of the beach. These groins are located as follows: Eleven brush and stone groins and three brush groins on the outside of the breakwater, perpendicular to it, and in the first 800 feet from the beacon; ten brush and stone groins and six brush groins on the outside of the plank bulkhead, perpendicular to it, and along a distance of 300 feet, commencing at a point about 1,800 feet from the beacon; one brush and stone groin at the beacon, on the inside of the bulkhead, and perpendicular to it; one on the inside of, and nearly parallel to, the plank bulkhead, about 500 feet long, commencing about 400 feet from the beacon; and one brush groin fills an interval on the plank bulkhead, about 1,700 feet from the beacon. In constructing these groins, 1,583 tons of small boulders were used.

Work was continued upon these groins under the appropriation of June 23, 1874, from the first of August until the latter part of November, 1874, when it was suspended for the winter. During the latter period, the following additional work has been done, viz. :—

Two thousand eight hundred and forty linear feet of stone and brush groins; 320 linear feet of brush groins built outside of the breakwater, and about 250 feet of stone and brush groins built inside of it; also a framework bulkhead filled with brush and stone,

eleven feet in length, built about half way up the beach, in order to strengthen it where broken through by the storm of November, 1873. In these groins and bulkheads, 1,617 tons of small bowlders have been used.

Of the appropriation made for this work, by the Act of June 23, 1874, there remains an available balance,
January 1, 1875, of \$1,445 21

For the further improvement and preservation of this harbor, the following sums will be required, viz :—

- | | |
|--|--------------------|
| 1. For completion of the work projected for the preservation of Long Beach, and for such repairs, planting of beach-grass, etc., as may be necessary, | \$2,000 00 |
| 2. Should it be decided to improve the harbor by dredging, as described in my special report to the Department, dated February 14, 1874, it is therein estimated that the cost thereof will be | 28,000 00 |
| Total, | <u>\$30,000 00</u> |

VII. IMPROVEMENT OF WELLFLEET HARBOR, MASSACHUSETTS.

All the sunken rocks have been removed from this harbor at its entrance and above, to the extent contemplated and deemed necessary, including Channel Rock, Mayor's Rock, Bay Rock, Lobster and Lumpfish rocks.

VIII. IMPROVEMENT OF PROVINCETOWN HARBOR, MASSACHUSETTS.

Under the several appropriations heretofore made for the preservation and improvement of this harbor, the following work had been done on the 1st of July, 1874, viz. :—

1. Bulkheads and jetties of various descriptions had been built from time to time along Beach Point for its preservation and protection, both by the United States government and by the local authorities.

2. A dike was built in 1868 and 1869 by the State of Massachusetts across the outlet of East Harbor Creek.

3. A dike was built in 1868 and 1869 by the United States government across East Harbor Creek, at the Wading Place, near High Head; about two miles above the outlet of the creek.

4. Wooden bulkheads and jetties had been built at different times for the protection and preservation of the beach on Long Point.

5. A stone bulkhead had been commenced for the protection and preservation of the outer end of Long Point, the lighthouse and the Three-Gun Battery.

6. A substantial dike (272 feet in length) was built in 1871-72 across the head of Lancey's Harbor, near Abel Hill.

7. Beach-grass planted on Beach Point, Long Point, Abel Hill, Cove Section and Oblique Section, and at the last two places brush had also been laid for their further protection.

8. The projected extension of the several jetties on Beach Point and State Dike had been completed ; and

9. Accurate resurveys had been made (1871, 1872, 1873 and 1874) of Cove Section, Oblique Section, Beach Point and Long Point, together with elaborate soundings and current observations in the inner harbor.

On the first of July, 1874, there was available for the improvement of this harbor (including the \$6,000 appropriated by Act of June 23, 1874),—

The sum of	\$6,103 48
Amount expended from July 1st to December 31, 1874, . .	4,817 03
Amount available, January 1, 1875,	<u>\$1,286 45</u>

The above amount expended since July 1, 1874, has been applied to building a bulkhead and jetties for the preservation of the beach at Cove Section, where encroached upon by the extraordinary gales of November, 1873, and January, 1874, as well as by subsequent gales ; to increasing the outer end of the stone bulkhead on Long Point ; and to the repair of the bulkhead and jetties on Beach Point, where most necessary.

The bulkhead and jetties at Cove Section were commenced in September and completed early in December, 1874. They are built of a framework filled with brush and ballasted with stone. The bulkhead is 607 feet in length ; and the jetties, six in number, have an aggregate length of 126 feet.

Since the completion of this work, its efficiency has been most successfully tested by a violent storm, which rushed over the beach and filled the space in front of the work to a depth of two to three feet with sand, adding greatly to its strength.

[C .]

EXTRACTS FROM ANNUAL REPORT

UPON THE IMPROVEMENT OF RIVERS AND HARBORS IN PART OF THE
STATE OF MASSACHUSETTS IN CHARGE OF G. K. WARREN,
MAJOR OF ENGINEERS, BREVET MAJOR-GENERAL U. S. A.

HYANNIS BREAKWATER.

During the past fiscal year, the appropriation of \$10,000 made by the Act of Congress, approved March 3, 1873, has been expended in the rebuilding and repairing of about 220 feet of the west end of the breakwater.

This work has been conducted with especial reference to making the wall above low water as solid as possible, so that it may best resist the force of the waves, and to bringing the slopes under water up to the angle required to insure permanence, which we think is attained here by making the seaward slope 1 upon 2 and the other 1 upon 1.

The west end, for the length of 220 feet, is now in a proper condition, but, as stated in my last report on this improvement, the remaining length of the breakwater is in an unsafe condition below low water. Many gaps exist in the seaward slope, which, together with its steepness, demand early repairs to prevent a breach in the parapet.

The estimates given below are for this purpose :—

4,000 tons of riprap granite, at \$3.50 per ton,	. . .	\$14,000 00
Superintendence, etc., 10 per cent.,	. . .	1,400 00
		<hr/>
		\$15,400 00

I deemed it advisable to make a survey of the harbor, sheltered by the breakwater, for the purpose of ascertaining the need and probable cost of enlarging the anchorage-ground by dredging, and herewith transmit a map of the same, and also the report of Mr. P. M. Blake, assistant engineer, who had charge of the work.

I find that a greater depth exists than shown on the Coast Survey chart of Hyannis Harbor for 1850, while the area available for vessels drawing more than nine feet is sufficiently large at present for the use of the coasting-trade.

All that is now needed to make this work permanently safe is a sufficient amount of riprap, properly placed, and the appropriation of

\$5,000 for the present year will be used, so far as it will go, toward the accomplishment of this object. I estimate that \$10,000 more will be required to complete these necessary repairs, and urge that an appropriation for that amount be made for the fiscal year ending June 30, 1876.

The removal of the light-house, as suggested in my former report, from its present position to the east end of the breakwater, is again recommended.

WAREHAM HARBOR.

At the close of my last annual report, August 30, 1873, the dredging operations under the appropriation of \$10,000, approved June 10, 1872, had just been finished; those under the appropriation of \$10,000, approved March 3, 1873, were begun September 1. Everything in regard to proposals, etc., for doing this work was given in my last annual report.

Before any improvement was made here, a depth of $7\frac{1}{2}$ feet at mean low-water ($11\frac{1}{2}$ feet at high-water) was the greatest depth that could be found over the bars, and only in very high tides could the latter depth be found over the ridge just below the wharves. The channel was, besides, so very crooked, and the form of the harbor such that vessels could only sail up or down with favorable winds, and the business of the town not warranting a tug, navigators were subjected to vexatious delays and losses.

The first appropriation of \$10,000 was sufficient to complete a channel 200 feet wide, through a ridge connecting the east shore with the main portion of Quahaug Bar, of which it may be said to have formed a part, thus affording a tolerably straight passage around the main portion of the bar, which was not touched. Dredging was also begun on the upper bar.

With the second appropriation of \$10,000, dredging was continued on the upper bar until the funds were exhausted, November 25, 1873. A channel about 120 feet wide was made around the upper bar, and the depth of 9 feet extended up to the town, leaving a channel nowhere of less width than 60 feet.

A large rock, weighing 28 tons, was also removed from the channel.

The amount of material removed during the working season of 1873, under both appropriations, which includes all that has so far been done besides the new survey and map, is as follows:—

From near Quahaug Bar,	21,862 cubic yards.
From near upper bar and up to the wharves,	24,901 " "
<hr/>	
Total,	46,763 cubic yards.

The further improvement of this harbor will require dredging at Quahaug Bar, to remove points where there is less depth than 9 feet at mean low-water, so as to make the channel there 200 feet wide and 9 feet deep; to remove a shoal opposite Barney's Point; to remove the main point of the upper bar and to widen above it, so as to make the 9-foot channel at least 100 feet wide in the straight portions and a somewhat greater width at the bends, to compensate for the greater room required by vessels in turning,

In the report of the first survey, made in October, 1871, was one estimate for removing ledge and bowlder in Weweantic River, of \$3,000. It does not seem now that the removing of these properly belong to the improvement of Wareham Harbor, but there are rocks in the channel leading to Wareham Harbor, just off the mouth of the Weweantic River, which have never been examined by us, and which should be removed, if practicable. We provisionally estimate the removal of these at \$3,000. The location of them is shown by four buoys, and the place is known to navigators as "Four Buoys."

The following is the estimate of the amount of work still required for the improvement of Wareham Harbor, as far as present interests will justify:—

Dredging on upper bar and vicinity, 24,107 cubic yards, at 35 cents,	\$8,437 45
Dredging opposite Barney's Point, 1,401 cubic yards, at 35 cents,	490 35
Dredging Quahaug Bar and vicinity, 15,678 cubic yards, at 35 cents,	5,487 30
Removal of rocks at Four Buoys (approximate),	3,000 00
Engineering and contingencies,	2,584 90
	<hr/>
	\$20,000 00

Amount on hand (appropriation approved June 23, 1874),	\$10,000 00
Amount required in addition,	10,000 00

It is proposed to do this work by contract. Wareham is the centre of an iron-manufacturing business, using a large quantity of iron and coal, nearly all of which is brought in through this channel.

This harbor is a port of delivery. It is in the New Bedford collection-district, and New Bedford is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1874, was \$21,095.47.

TAUNTON RIVER.

At the date of my last annual report, August 30, 1873, the removal of bowlders from this river was in progress; it was con-

tinued until October 10, when the portion of the appropriation assigned to this purpose was expended; it has been productive of much good.

A contract for dredging, at \$2 per cubic yard, had been made with Mr. E. R. Seward, of Albany, N. Y., he to begin June 1, 1873, and complete November 30, 1873. His contract was afterward extended to June 30, 1874, to allow him time to finish the work at Norwalk, Conn., under my charge, before beginning this. The dredging was diligently prosecuted from October 24 to November 26, 1873, and again from March 11 to March 31, 1874, when the appropriation was expended. The shoals known as Blake's Table Rock and Sheep Pen were thoroughly removed, and a cut about 25 feet wide and 600 feet long was made through Chabbot Rock Shoal, the depth of each being 9 feet at mean high water. The following is the amount of work done:—

Material dredged,	3,443.42 cubic yards
Rocks and stones removed,	224.50 “ “

On the completion of work, a survey was made of the channel dredged and of several obstructions near Dighton, detailed examinations of which had never been made.

The future work contemplated is the removal of the remainder of the upper shoals, by dredging, and of the obstructions from Berkley bridge to Dighton, consisting of dredgeable materials and rocks.

The estimate for the whole improvement is somewhat increased over that of last year by the addition of the estimate for the shoals near Dighton, not before included, and for other minor reasons stated in the annexed report of my assistant.

Dredging, at \$2 per cubic yard for upper shoals, and 50 cents lower,	\$16,470 50
Removal of rock, at \$8 per cubic yard,	2,400 00
Engineering expenses and contingencies,	3,129 50
Total,	\$22,000 00
Less appropriation for fiscal year ending June 30, 1875,	10,000 00
For year ending June 30, 1876,	\$12,000 00

All of this could be advantageously expended in one year.

SURVEY OF WOOD'S HOLE.

This is one of the surveys directed by the Act for improvement of rivers and harbors, approved March 3, 1873, which has been intrusted to me.

In the estimates submitted, the smallest one, \$5,000, will remove a few of the worst rocks that now interfere with the running of the steamboats between New Bedford and Martha's Vineyard. This improvement will be of benefit principally to them. It is much more advisable, however, to appropriate the \$22,000 estimated for a more thorough removal of the bowlders. This will be of benefit to a large number of sail-vessels, and a great deal more good can be done with it, in its proportion, than with the smaller sum, because it is a difficult place to operate in, and the necessary preparations will consume a large part of the smaller amount and leave but little to work with. When adequate preparations are once made, it is very desirable to continue the work until it reaches a satisfactory conclusion.

Our estimate further includes a larger sum for continuing the improvement by dredging, and otherwise to enlarge the passage to a capacity adapted to the use of our coastwise sailing fleet, whenever it is advantageous to make the passage through Buzzard's Bay instead of the opposite portion of the Sound. It may be too soon to begin this now, but it will ultimately be necessary; and, while upon the subject, we have made our plans complete and looking toward such final accomplishment. All the partial improvements proposed are, as far as they go, directed toward this final end, while at the same time affording the greatest benefit.

This improvement may truly be called a national one. It is not for the benefit of the special locality. It is for a navigable highway, uniting two large bodies of navigable water extensively used by the commercial vessels of the United States, and when thoroughly improved it will tend greatly to a saving of time and diminish the dangers of navigation. The circumstances under which its use is particularly desirable, and the reasons for it in detail, are given in Mr. Cotton's report.

In conclusion, I would say that I consider \$22,000 as the most desirable amount with which to begin this work.

In 1852 there was an appropriation of \$2,500 made for the improvement of Great Wood's Hole Harbor. This was spent in building a breakwater on its northern side to close a passage through which water passed between it and Buzzard's Bay. The report of this operation is found in the Annual Report of the Chief of Engineers for 1853. It would appear that the work was left incomplete, as an additional appropriation of \$2,000 was solicited. Private parties have, however, since continued the work, and occupied the vicinity, so that the opening is entirely closed at the present time.

SURVEY OF THE HARBOR OF FALL RIVER.

This survey was authorized by the Act of Congress, approved March 3, 1873, and was, as stated in the Act, made with a view to the removal of rocks from this harbor.

This survey extends along the harbor-front about 1,500 feet, between Rodman's wharf and Brown's wharf, and out to the curve of 14 feet depth at mean low-water.

The most obvious obstructions in this space are boulder-rocks of all sizes up to several tons weight; but besides these the surface on which they lie is too shoal, and requires dredging.

We have made an estimate for the removal of the rocks and the dredging separately, and also for a few dolphins to mark out the channel, when improved, and to guide and aid vessels in getting in and out.

The improved channel thus to be provided is to be 12 feet deep at mean low-water, and 100 feet wide at the narrowest parts, widening out at each end, where it joins the main channel.

The estimate is as follows:—

For removing bowlders,	\$11,000 00
For dredging,	33,400 00
For six dolphins,	600 00
	<hr/>
	\$45,000 00

The Act of Congress, approved June 23, 1874, appropriated \$10,000 for the removal of bowlders from this harbor. It is proposed to extend this in the removal of bowlders by contract, after advertising in the usual manner.

The work will probably be done this autumn and the following spring.

The whole estimate of the improvements at this place was \$45,000. The present appropriation will probably enable us to remove most of the bowlders, leaving the dredging and putting in dolphins to mark the channel till further means are provided.

It would be most economical to have all the rest of the estimate (\$35,000) at one time, and it could all be advantageously expended in one year. The full value of removing the bowlders will not be realized until the whole work is done.

Fall River city is a most commercial place, and too well known to need special mention here. It is a port of entry, and the amount of revenue collected in the fiscal year ending June 30, 1873, was \$212,491.42.

The revenue collected during the fiscal year ending June 30, 1874, was \$93,128.23.

[D.]

RETIREMENT OF HON. DARWIN E. WARE.

The Board of Harbor Commissioners was established by Act of July 1, 1866, and the Commissioners were appointed by Governor Bullock. Mr. Ware was one of the original members so appointed. At the expiration of his first term of two years' service, he was reappointed by Governor Bullock, and at the expiration of his second term of five years' service, he was again reappointed by Governor Washburn. Mr. Ware tendered his resignation in October, to take effect when a new Commission was appointed, and continued to act with the Board up to December 12.

It is no injustice to the other members of the Board to say that a laborious part of its duties and responsibilities have been borne by Mr. Ware. His legal knowledge and judgment in dealing with the complicated questions connected with the work of the Commission, has been of a value to the Commonwealth which it desires to record.

On the announcement of his resignation, the following resolutions were adopted:—

Resolved, That we learn with regret that the Hon. Darwin E. Ware has resigned his position as a member of this Board; we embrace this opportunity which the occasion furnishes to place upon our records our sense of the value of his services to the Commonwealth, and our appreciation of his merits as an associate and friend.

Becoming a member of the Board upon its original organization in 1866, he was instrumental in shaping its policy and methods; his time and eminent legal talents have been promptly rendered to its service whenever required, and we feel that to him, in a large measure, it is indebted for its past success and the reputation it enjoys as an important department in the administration of the affairs of the state.

Resolved, That we tender to him our heartfelt wishes for his continued prosperity and happiness; we part with him officially with many pleasant recollections of his courtesy and kind feelings while in the discharge of the public duties in which we mutually have been engaged.

[E.]

[Chap. 34, Resolves of 1874.]

RESOLVE IN RELATION TO THE FLATS, MEADOWS AND BEACHES ON EAST
HARBOR CREEK IN PROVINCETOWN AND TRURO.

Resolved, That the board of harbor commissioners is hereby authorized to compromise and settle in behalf of the Commonwealth any demands, that seem to the board just, of any persons or corporations, for injuries resulting to meadows, flats and beaches, in Truro and Provincetown, in the county of Barnstable, from the construction by the Commonwealth of a dike across the outlet of East Harbor, or to purchase in behalf of the Commonwealth the fee of said meadows, flats and beaches, or of any part of them, and to receive on behalf of the Commonwealth conveyances or releases of the same, or agreements concerning the same: *provided, however*, that such settlements, purchases, conveyances, releases or agreements shall be subject to the approval of the governor and council; and that there shall be allowed and paid out of the treasury of the Commonwealth for the purposes of this resolve a sum not exceeding ten thousand dollars, and the harbor commissioners may in making any purchase of any said meadows, flats and beaches, or after the same have been conveyed to the Commonwealth make any agreements concerning future occupation of the same or concerning any rights or interests of persons or corporations in the same which to said board may seem fit and proper, subject, however, to the approval of the governor and council.

Approved April 21, 1874.

[Chapter 347, Acts of 1874.]

AN ACT IN RELATION TO STRUCTURES IN TIDE-WATERS.

Be it enacted, &c., as follows:

SECTION 1. The board of harbor commissioners is authorized and empowered to license any person to build or extend any wharf, construct any pier, dam, sea-wall, road, bridge or other structure, or to fill land or flats below high-water mark and beyond the line of riparian ownership in and over tide-water along the shore of which no commissioners' or harbor line has been established by law: *pro-*

vided, however, that no such license shall have any validity beyond the line of riparian ownership unless approved by the governor and council ; and *provided, further*, that no such license shall be granted under the authority of this act for the construction of a bridge across any river, cove or inlet in any location not above the line of some existing bridge or other structure authorized by law over such tide-water in which there is in fact no draw and in which the law does not require that a draw be constructed or maintained or in case the mayor and aldermen of the city or the selectmen of the town within the limits of which the work licensed is to be done shall after the notice to them required by law appear and oppose the granting of the same. But the recital in such license that no such opposition has been made and the recital in any license of the said board that the notice required by law has been given shall be conclusive evidence of the facts recited.

SECTION 2. Every license granted under the authority of this act shall be subject to the provisions of the third and fourth sections of the two hundred and thirty-sixth chapter of the acts of the year eighteen hundred and seventy-two.

SECTION 3. This act shall take effect upon its passage. *Approved June 19, 1874.*

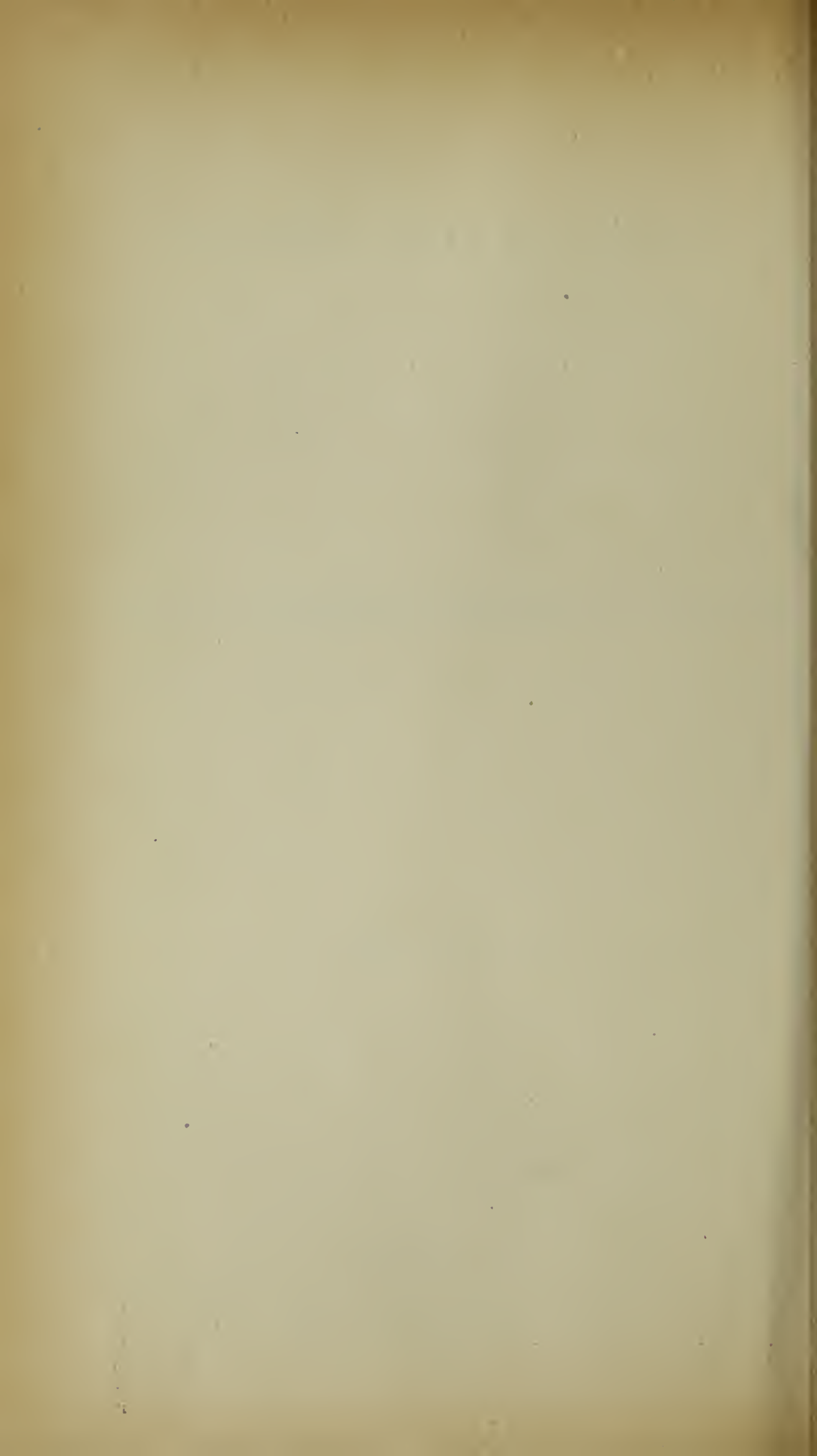
TENTH ANNUAL REPORT

OF THE

BOARD OF HARBOR COMMISSIONERS.

JANUARY, 1876.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
79 MILK STREET (CORNER OF FEDERAL).
1876.



R E P O R T.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor Commissioners respectfully submit their Tenth Annual Report.

SOUTH BOSTON FLATS.

The initiation of the harbor improvement, usually discussed under this head, was due to the studies of various commissions and legislative committees prior to the establishment of the Board of Harbor Commissioners. It was at the same session of the legislature at which this Board was created that a definite plan for the improvement was adopted, and it was among the first duties of this Board to present to the legislature a scheme for carrying into execution the improvement upon the basis of that plan. The plan of 1866, of which we speak, was not a plan for utilizing the flats when filled; it only showed the extent and outlines of the proposed filling,—the walls and channels. Whatever idea was at the outset entertained of utilizing the tract of flats that should be inclosed, was incidental merely. The project was primarily a harbor improvement. A wall was proposed to be built on a certain line, the position of which was determined by a physical survey of the main channel. This wall was designed to effect certain changes in the tidal currents, and also to retain the material dredged from the harbor. The anchorage and sailing-room of the harbor was to be materially increased, and the modifications in the flow of the currents induced by the wall was relied upon in part to secure the permanence of the improved water-way. The Resolve of 1866, which first committed the subject to this Board, fully recog-

nized the project of reclaiming and utilizing the flats which should be inclosed, but contained these words: "In all plans and proposals submitted by them, always regarding the protection and improvement of the harbor of Boston as of paramount importance in any intended occupation of said flats." The Board thus undertook the work with two purposes in view, and mature study confirmed the opinion that the two were entirely consistent with each other. The flats offered the most convenient dumping-ground for the material dredged from the main channel, and the market value of the reclaimed land would depend largely upon the improvement of this channel. Some doubt was at first entertained whether, if the project were considered solely with reference to the land to be filled up, it would not be cheaper to bring the material from the country by railroad than to obtain it by dredging; but it is now evident that the material can be obtained from the harbor at about four-fifths the cost of obtaining it from the country. It was early seen that the reclamation of the whole territory could not be undertaken as a single project, and accordingly it was divided into three sections, numbered in the order in which the filling would be likely to proceed. The first section extends from Fort Point Channel to a line drawn from the foot of E Street, in the easterly line of said street, to Slate Ledge Buoy, and comprises 341 acres. The second section extends from the easterly line of the first section easterly to a line parallel with that, and which intersects the established line for the proposed sea-wall 3,400 feet from said first section. This section, upon the original plan, is traversed by a reserved channel 500 feet wide. Between this reserved channel and the line of the proposed wall is an area of 157 acres; the reserved channel in this section comprises 57 acres, and between it and the shore are 87 acres, making the total area of the second section 301 acres. The third section extends easterly from the second section to a line drawn from the wharf near the southern point of Castle Island to South Boston Point, and comprises an area of 283 acres, eight acres of which are occupied by the reserved channel in the original plan. The entire area of the three sections comprises 925 acres. The reserved channel was originally designed to traverse the first section

also, but the purchase of the flats owned by private parties in that locality will make it inexpedient that it should do so; and it is not unlikely that, as the work progresses, it will be seen to be for the interest of all parties that the plan of a reserved channel should be discarded altogether. The filling for which provision has actually been made, comprises less than one-third of the first section, and about one-ninth of the entire territory. It consists of about 25 acres owned by the Boston Wharf Company, about 25 acres owned by the Commonwealth, and about 50 acres owned by the Boston & Albany Railroad Company. The amount of material required to fill these three parcels to grade 13, is estimated as follows: For the Boston Wharf Company tract, 622,471 cubic yards; for the tract of the Commonwealth, 504,305 cubic yards; and for the Boston & Albany Railroad tract, 1,155,891 cubic yards. The Boston Wharf Company is not under obligations to dredge from the main channel, but has agreed to deepen Fort Point Channel in front of its territory over an area of 604,550 square feet to not less than 12 feet at mean low water, requiring the removal of 144,644 cubic yards, leaving 477,827 cubic yards required by the company, which is being obtained by them from the cheapest sources available, mostly from dredging in docks and other portions of the harbor. The material required for the other two tracts provided for, and which must be dredged from the main channel, is 1,660,196 cubic yards, as above. In the second annual report of this Board, a plan was given upon which the space proposed to be dredged was colored red. In this portion the 23-foot channel was contracted to a width scarcely 70 feet, and its course was so serpentine, that, even at points where it was much wider, no heavy vessels could follow it under ordinary circumstances. Of course, it is only the very heaviest vessels that would require a channel of such depth. The 18-foot channel which ordinary laden vessels require, had a minimum width in this locality of about 900 feet, and answered very well when not encumbered, as it often was, by vessels at anchor. The dredging proposed will increase the channel to about 2,400 feet in width to the full depth of 23 feet, and add to the anchorage-room for heavy ships about 174 acres. The space colored red in the plan

mentioned contained, above the level of 23 feet below mean low water, 1,458,000 cubic yards, as computed from measurements in position, of which 1,275,000 cubic yards were between the original 23-feet channel and the line of proposed sea-wall; but when shovelled up by the dredge, and dumped upon the flats, it is estimated there will be a gain in measurement of 30 per cent. Thus, without going north of the old channel at all, the contractors will find all the material required for filling to grade 13 the parcels now under contract. To what extent the material will settle when deposited, cannot be predicted; but the grade provided by the contracts being 16 when covered with gravel, will be sufficiently high to admit of all the settlement probable without material injury of the land for occupation. In the Second Report, before referred to, the figures for the dredging and the filling were evidently confounded. Three and a half millions of cubic yards are mentioned as the amount to be derived from the space colored red upon the plan, added to the amount to be furnished by the general government from operations at the upper middle bar. This was at a time when a channel 1,000 feet wide was in contemplation, and the depth of dredging was to be two feet greater. In New York Harbor, the general government long ago fixed upon 25 feet at mean low water as the depth to which rocks should be removed; but, in the case of Boston, 23 feet has been regarded as sufficient, and adopted both in the operations of the general government and of the Commonwealth. In New York, 25 feet at mean low water is a trifle over 27 feet at the mean sea level; *i. e.*, at half tide. In Boston, 23 feet at mean low water is 28 feet at half tide; so that a vessel requiring a whole flood or ebb tide to come up or go down, will find one foot more water upon the shoalest places than she would find with the smaller tide in New York Harbor.

There are occasionally in Boston steamers drawing a little over 23 feet, very rarely 24 feet. It would be far from true economy to remove all obstructions to an additional depth of one foot, to meet the chances of a rare ship visiting these interior obstructions at low water, and impatient of an hour's delay in the comfortable roadstead below. If the present grade of filling required to be taken from the harbor shall

be maintained till the reclamation of the first section is complete, Boston Upper Harbor will then be as perfect below the navy yard as it need be for the requirements of the heaviest commerce.

The progress of the work upon the Commonwealth tract of 25 acres during the year has been satisfactory. The Board found early in the season that advantageous prosecution of the filling would require the construction of the dock-walls earlier than had been proposed. With the approval of the governor and council, a contract was made for this purpose on the 23d of June,—which will be found in the Appendix,—and work under the same was immediately begun.

The studies and experiments of the engineer in charge to test every step in the work in the most exhaustive manner, will be found exceedingly interesting, as stated in his report, which is printed herewith, and will afford the legislature means of judging the degree of caution that has been observed.

This Board have never doubted that the land reclaimed by this harbor improvement would alone bring to the treasury of the Commonwealth a full return for its large expenditure; and, as the reclamation of the portion under contract approaches completion, there are many indications which confirm that confidence. The legislature of 1875 repealed the power of this Board to make sales of the land to be reclaimed, and created a new Board to deal with and develop the property created by the reclamation. This Board are also advised that the new legislation, by conferring upon the new Board power to make contracts for future improvements upon the flats in question, has by implication repealed the power of this Board to make such contracts; and that, beyond the completion of the work now under contract, their duties in connection with the improvement of the harbor upon South Boston Flats will be of a negative character, and of much less responsibility than heretofore. The views of the Board in this connection were presented to the committee who reported the change of policy referred to, and were appended to the committee's report (House Doc. 365); and, for convenience

of reference, the communication is also printed in the Appendix to this Report.

A further appropriation will be required for the prosecution of the work under contract, in accordance with the report of the engineer.

CHARLES RIVER BASIN.

In July, 1874, the Board granted a license to James A. Woodbury, S. A. Woods, and Fred Pope, which provided for a project of improved commercial frontage upon the Cambridge side of Charles River, and at the same time secured the improvement of the channels of Charles River between Cragie and Brookline bridges, as compensation for the privileges granted. The first-named parties have since transferred their interests to the Cambridge Improvement Company, who, in October, 1874, commenced operations under the terms of the license granted. By the close of the season, 600 feet in length of the wooden bulkhead, forming the westerly side of the reserved canal, had been completed in a satisfactory manner. The work of ballasting this bulkhead was continued through the winter, and in April, 1875, contracts for dredging were made by the company, since which time 9,698 cubic yards of material have been taken from the reserved canal, deepening its channel to from three to four feet below mean low water. The material removed by this dredging has been deposited in lots in rear of the bulkhead, but this filling is not included in the measurement of compensation for tide-water displaced, as it was not taken from the main channel outside of the harbor lines of the basin, although it adds to the commercial advantages of the general improvement.

In April, 1875, dredging was begun in the main channel of the basin, according to the terms of the license. This work has progressed in a satisfactory manner, and, up to December last, 53,140 cubic yards of material have been removed, giving a depth of 10 feet at mean low water where the dredging has been done. In April, work was also begun upon the foundation for the sea-wall, 500 feet of which has since been satisfactorily completed in a manner believed to be superior to ordinary pile-foundation work. In September, the work of building the sea-wall proper, upon this prepared

foundation, was begun, and considerable progress has since been made.

Several sales of the filled lands have been effected, and a substantial building erected by the American Net and Twine Company. The prospects of the Improvement Company are encouraging, and seem to indicate a successful development of their enterprise.

A progress sketch of the work of the company is appended to the report of the Board.

SHOALS IN BOSTON UPPER HARBOR.

By chapter 304 of the Acts of 1874, the Board was authorized to use the income from the compensation fund for Boston Harbor accruing during that year, together with the amount received from assessments for compensation for tide-water displaced, to pay for dredging away shoals off the city frontage, to an amount not exceeding \$15,000.

The Board made surveys of the ground in question, and issued proposals for the intended work; but, as stated in their last report, circumstances determined them to postpone dredging for that season.

During the past year, contracts have been made for the removal of part of the shoal off Constitution Wharf and Battery Wharf, under which work has been done and paid for to the amount of \$8,000. Owing to difficulties which the contractor has experienced, the whole amount of the dredging agreed upon has not been done, and a portion of the shoal off Battery Wharf is not yet removed. By law, the unexpended balance of the appropriation for this work reverts to the treasury with the end of the fiscal year, leaving the Board without funds to continue further operations.

Besides the original project, it will be desirable to dredge away more of the shoal ground in this vicinity. The Board has also had notice of an increasing shoal off the water-face of East Boston, which will be examined as soon as practicable.

In order to conduct this work, the Board will require additional funds, and would respectfully recommend the appropriation of the income from the harbor fund for 1875 and 1876.

From the fact that the Man-of-War or Junction Shoal is a "middle-ground" in the channel leading to the United States

Navy Yard, the Board deems its removal appropriate work for the general government, and has memorialized Congress in behalf of an appropriation for it.

The memorial is printed in the Appendix, and a hydrographic sketch of Man-of-War Shoal is also appended.

PRISON POINT BAY.

Under an Act of the legislature approved May 26, 1868, the city of Charlestown was authorized to inclose and fill up, under the direction of this Board, all of those flats included within the north-easterly side of the Boston and Maine Railroad location and the high-water line of the Charlestown shore. Among the provisions of this Act was one requiring compensation to be made from time to time for the amount of tide-water displaced by the filling up of flats.

The city of Charlestown did not avail itself of the authority conveyed in the aforesaid Act, so far as to undertake any general reclamation of the bay, but proceeded to extend Canal Street across a portion of it, and ultimately to fill an adjacent place. This street extension involved the inclosure of a portion of the bay lying between the location of the street and the shore of Charlestown, amounting to about four acres; but two culverts were placed under the roadway so as to provide for adequate ingress and egress of tide-water.

Soon after the work upon the extension of Canal Street was fairly under way, the owners of flats in this portion of Prison Bay, and especially those who held flats within the street location, busied themselves with reclaiming lands for building and other purposes; so that by the time the filling along the line of the street had risen above high water, the interior basin had been nearly filled up. The northern culvert having by this time ceased to be of use as a tide-way to any flats except those belonging to the city, the city proceeded to fill up the narrow space that remained.

This Board assessed upon the city of Charlestown compensation for tide-water displaced along the site of Canal Street and in the rear of the northern culvert, and the amount assessed was paid by the city of Boston after the annexation of Charlestown.

While the filling of Canal Street was in progress, notice was

given to private parties engaged in reclaiming adjacent flats that this action was illegal, and finally a state constable was sent to the neighborhood to observe and report such proceedings. The Board having given adequate time to all the parties for taking the necessary steps to legalize their proceedings, and finding them apparently indisposed to do so, notified them to appear at a meeting of the Board held November 4th of this year. At this hearing, numerous parties in interest appeared, and those representing property within the line of Canal Street claimed that the cutting off of the portion of the bay reclaimed by them from the free ingress and egress of the tide was the act of the city of Charlestown, for which they ought not to be held responsible.

While the Board cannot admit this claim, because it is satisfied that the city provided adequate water-ways for the tide, it cannot but regard the situation of the parties as one claiming consideration. The city of Charlestown presented no plans for approval by this Board before proceeding to construct the street which actually deprived the parties within of all value in their property as *water front*, and converted their flats into receptacles for filth; so that the injured parties were presented with no opportunities to be heard before this Board till the work of the city, actually in progress, foreshadowed their fate; they then proceeded to convert their flats into building lots, believing that the city by its action had assumed all responsibility.

GREEN HARBOR RIVER.

The attempt to reclaim 1,500 acres of unproductive marsh land, by a dike across Green Harbor River, is an experiment of more than ordinary interest to the Commonwealth. The progress and ultimate value of the reclamation, as such, is the more appropriate study of the board of agriculture, from whom the legislature will doubtless receive reliable data for estimating the results of the dike to the agriculture of the State.

It was suggested in the fifth annual report of this Board, that the dike would not remain neutral in its relations to the harbor and its entrance, and the result has proved quite as serious as then anticipated. The predictions of Prof. Mitchell,

printed with that report, have been verified with striking accuracy.

The Act which authorized the construction of the dike, chapter 303 of the Acts of 1871, contained as its fourth section the following :—

“Should shoaling take place above the level of mean low water in the channel of Green Harbor River or its approaches below the dam and dikes in consequence of the construction of said dam and dikes, said shoaling shall be removed by the proprietors of Green Harbor marsh, under the direction and to the acceptance of the board of harbor commissioners. And if the proprietors of said marsh shall fail to remove said obstructions for six months after due notice from said commissioners, then said commissioners shall cause the obstructions to be removed at the expense of the proprietors of said marsh, and said proprietors shall be liable to the Commonwealth for the same in an action of contract, and the non-joinder of any party or parties defendant shall not defeat the same.”

Questions arising under this provision have claimed the attention of the Board the past year. Petitions were presented alleging that the shoaling there contemplated had taken place, and praying for the relief therein provided. The Board, with its engineers, visited the harbor in August, and inspected its condition at various stages of the tide. A partial hearing was given at that time to the petitioners and such meadow owners as appeared, and subsequently in Boston a more extended hearing was had, at which testimony was introduced on both sides, and the views of the different parties interested were ably presented by counsel. The harbor has suffered a decided injury from closing the tidal reservoir which the marshes afforded. The channel of the river and its approaches were formerly cleared by the daily scouring of the outgoing tide, so that boats drawing two feet could enter freely at all stages of the tide, but now the bar at the entrance does not admit of sufficient depth at low water for the use of boats of any description. Shoaling has undoubtedly taken place both in the channel and its approaches above mean low water. Natural causes have contributed to the shoaling to some extent, and it would not be practicable to separate with precision the results of natural causes from the results of the dike,

but it is clear that what has occurred must be mainly attributed to the dike. A further survey will be necessary to determine the extent to which the obstructions should be removed to meet the requirements of the statute, which survey will be made as early as the weather will permit.

It is obvious that much injury has resulted to the harbor for which no remedy was attempted in the statute ; and whether the provision cited is effective for the relief which was attempted, is not clear. A doubt has arisen,—Who are “the proprietors of Green Harbor marsh,” that are required to remove the obstructions caused by the dike? It is not certain whether the statute would be construed to mean those who were proprietors at the passage of the Act, those who were proprietors at the time the dike was constructed, those who shall be proprietors when the Harbor Commissioners shall give notice of the obstructions to be removed, or be held void for indefiniteness. There is no express provision that the cost of removing the shoaling shall be a lien or charge upon the land ; and if the responsibility is personal only, there is great difficulty in determining upon whom it is placed. The statute makes it the duty of the Board to remove the obstructions, if the proprietors fail to do so for six months after notice ; but the means are not provided for the work, and the Board cannot proceed in it without further legislation. If the means are provided, and the obstruction should be removed by the Commonwealth in the first instance, the treasury would be involved in the question of whom the Commonwealth could recover the cost.

The petitioners, however, suggest that if the proprietors of the marsh fail to remove the shoaling for six months after notice from this Board, the dike will become a nuisance liable to abatement, the condition of its construction and maintenance not being complied with. If the proprietors should remove the shoaling to the acceptance of this Board, the relief may be temporary only. The cause would remain likely to produce again the same result, and it is not certain that the statute extends to a second removal. The counsel for marsh owners express doubt of the constitutionality of the provision cited, however it should be interpreted.

These difficulties lead the Board to the conclusion that the

remedial section of the statute will be more productive of litigation than of harbor improvement. If there is any effective restoration of Green Harbor River as a harbor, it is likely to be by the direct action of the State to remove the shoaling which the dike has caused. The interest manifested at the hearings of the Board indicates that the value of the harbor to the community affected by its injury was underrated in the earlier discussion of the dike project. The harbor was mainly used by small pleasure-yachts and fishing-boats. It was never valuable for refuge or for general commerce; but for the local purposes named it was valuable, and it fostered an important industry. To the fishermen who used it, the law that permits its injury seems oppressive. Whether the importance of the marsh reclamation justifies the injury of the harbor, or the expense of preserving it, is for the legislature to determine. The Board desires only to bring to the attention of the legislature the full consequences of the measure.

MENEMSHA CREEK.

During the last session of the legislature, the subject of the improvement of Menemsha Creek on Martha's Vineyard, by reopening a former inlet through the beach, was brought before it by petition, and subsequently referred to the Board of Harbor Commissioners for examination, and report to the next legislature. In fulfilment of the instructions given, the Board respectfully submits the following report.

Menemsha Creek is the communicating channel or passage-way between the waters of Vineyard Sound and a large lagoon, or pond, called Menemsha Pond, which lies between the towns of Chilmark and Gay Head, and contains in total area, with one or two smaller connecting ponds, about 716 acres.

According to the early history of this creek, its outlet was farther eastward than it has been since, and near where the beach joins the upland. About 1770 it either broke, or was dug "square out" in the alignment of the main trend of the creek. This new channel, or outlet, gradually worked to the westward, ran crookedly through the beach, grew more shallow, and in the year 1842 closed up. In April, 1843, by volunteer labor, a new inlet was again dug through the beach "square out," as the report says. This cut remained as a

good channel, having five feet of water in it, until the great gale of June, 1853. The action of this gale so injured the creek, that it has been gradually deteriorating since. The creek is now narrow and crooked in its pathway through the beach, the entrance is from one-fourth to one-third of a mile westward from the site of the original cut, and has but about one-half a foot of water in it at low tide.

The arguments of the petitioners in behalf of the proposed improvement are substantially as follows: That opening a new inlet by an artificial cut through the beach at the point where it was formerly successfully made, and where for ten years it afforded a good and safe entrance to the shelter of the upper creek and pond, is a practicable and feasible undertaking; that such an inlet, leading to a safe harbor within, is much needed as a measure of advantage and encouragement to the fishing interest of this part of the Commonwealth, and also as a means of protection to the life and property of citizens engaged in this exposed and laborious business. The number of boats engaged in the fisheries of this general locality, and which now make Menemsha bight their headquarters, is about two hundred. With a good inlet and a safe harbor for refuge and for business accessories, the number and value of the boats and the amount of material property attending an advantageous fishing depot, would probably largely increase. The codfish caught upon the banks of No Man's Land, are among the best offered in the market. The lobster fishery in this vicinity is also of valuable and increasing interest, and the fish themselves are of a large and superior kind.

The Board, with their engineers, visited the ground of the proposed inlet at Menemsha, in August last, and had a hearing of parties interested in the proposed improvement, and obtained from undoubted authority valuable facts and particulars in reference to this subject.

The attention of the Board was called to a pier built at the entrance of Sesuet creek in East Dennis, on Cape Cod, for the purpose of protecting its inlet, confining and directing its currents, and preventing it from shifting under the influence of outside currents and wave action similar, it was thought, to those acting upon the shore at Menemsha. This pier at East Dennis has stood in good condition for nearly thirty

years, and has fully answered the purpose and produced the effect intended. The engineers of the Board have visited and examined this work, and report it to have served a valuable purpose in preventing the same sources of trouble apprehended in the case of Menemsha Creek. The uncertainty of a new opening remaining in its original position, and the probability of its deterioration if the entrance works to the westward, as the former openings have done, is the only adverse feature of the proposed improvement. The Board recommends the construction of a similar pier in addition to the proposed cut.

The Board ordered a survey of the ground at Menemsha to be made by their engineer, with an estimate of the probable expenses of such work as would secure an inlet affording the advantages desired. This survey has been made, and the following results obtained.

The most favorable and suitable location for the proposed cut through the beach is not in a line at right angles with the trend of the outer beach, but one beginning on the inside at the bend of the creek and inclining slightly westward, so that the channel and current through it shall partially coincide with the natural outside currents and influences which tend in this direction.

The location selected also avoids the higher portions of the sand-hills, and passes through about a minimum section of the beach. The length of this cut from low-water mark at either end is about 380 feet, and its width from its high-water line on either side should be about 80 feet, with a central cut of 40 feet in width dug to the level of low water, with slopes on either side. This would require an excavation amounting to about 5,220 cubic yards; allowing for irregularities of slope and other contingencies in the extension of the work, say a total of 5,500 cubic yards, which will probably cover all the required excavation. Owing to the remoteness of the locality, and the small amount of work required, it will probably be found inexpedient to provide improved machinery and appliances for its execution. A full allowance per cubic yard of dredging should be made for hand and team labor, but as the material is mostly beach sand, the following estimate is submitted:—

For opening a new inlet,	\$2,000 00
For pile pier similar to that built at East Dennis,	2,500 00
For closing the present inlet,	500 00
	<hr/>
	\$5,000 00

RESOLVE CONCERNING THE ESTABLISHMENT OF PIERS INSTEAD
OF BUOYS IN THE BAYS OF CAPE COD, GURNET HEAD,
AND DUXBURY AND KINGSTON BAYS.

During the last session of the legislature the Board received a communication transmitting a copy of chapter twenty of its Resolves, as follows:—

Resolved, That the harbor commissioners are directed to collect information in regard to the expediency of recommending to the government of the United States to substitute permanent piers instead of temporary buoys at the mouth of various harbors on Cape Cod, where the wide range of flats, dangerous to navigation, prevents the proper sighting of headlands in foggy or stormy weather, and also the propriety of establishing breakwater piers at the outlet of Cut River and the Gurnet Head, and permanent buoys on the northerly end of Brown's Island, so called, at the entrance of Plymouth, Duxbury, and Kingston bays, and report to the next general court such information and their conclusion thereon in their annual report.—*Approved March 31, 1875.*

After investigation in regard to the subject of the above Resolve, the Board would state there are practical objections to the substitution of permanent piers for buoys in the bays of Cape Cod. The distance from channel-ways at which piers would have to be placed in locating them upon the "wide range of flats" referred to, would involve the same difficulty which now exists in sighting natural landmarks. In order to make piers conspicuous, and answer the purposes desired, they must be large and expensive structures. The experience of last winter has shown the destructive power of ice in this part of Massachusetts Bay, where even light-houses have been endangered by it. The use of large and particularly marked buoys seems to be a more practically useful, and certainly a far more economical, way of aiding navigation in these waters. In view of these considerations, the Board deems it inexpedient to recommend to the general government the action suggested in the above Resolve.

In regard to the establishment of breakwater piers at the outlet of Cut River, the Board would state that the question of the condition and improvement of Green Harbor, which includes that of the mouth of Cut River, is now before them for consideration, and until definite conclusions are arrived at in regard to it, based upon intended surveys, the Board considers other action inexpedient.

In regard to a breakwater at Gurnet Head, the Board is not possessed of data or information sufficiently important to warrant the recommendation to the general government of the execution of such a work at this time.

The Board would unhesitatingly recommend the placing of large and conspicuous buoys, as permanently secured as practicable, on the northerly end of Brown's Island, at the entrance of Plymouth Harbor, as specified in the Resolve.

FLATS OWNED BY THE COMMONWEALTH.

On the 15th of May, 1875, the following communication was received from the Massachusetts House of Representatives:—

Ordered, That the harbor commissioners, in their next annual report, be requested to make an approximate statement of the location and amount of flats owned by the Commonwealth on its coast and harbors, so far as that information can be conveniently collected from existing maps, charts, surveys or other knowledge in their possession.

In accordance with the above order, the Board has obtained, mostly from the maps of the United States Coast Survey, and partly from their own surveys of Boston Harbor, the following information in regard to the amount of flats owned by the Commonwealth in its various harbors and along its coast. The amounts stated in the following table are given in acres, and are approximations only; but are probably considerably within the amount actually claimable by the State, as the limits of the flats are taken at mean low water, whereas the claim extends to the range of extreme tides.

As will be seen by the following tables, the main portion of the flats are in the harbors north of Cape Cod. This is owing

to the greater range of tide which prevails in Massachusetts Bay and along the eastern coast, and which averages about ten feet rise and fall, whereas, along the southern coast of Massachusetts, the tide ranges from one and one-half feet off Nantucket and Martha's Vineyard, to about five feet in Buzzard's Bay.

The total amount of flats owned by the Commonwealth, according to the basis of measurement taken, and which represent the flats that ebb dry below or beyond the line of 100 rods from high-water mark, as shown at mean range of tide, is 10,788 acres.

This line of limitation is in accordance with the old colonial law giving to proprietors of upland the ownership of flats to low-water mark, or to 100 rods below high-water mark where the flats extend beyond this range.

*Area of Flats owned by the Commonwealth of Massachusetts, being the Area outside the line of 100 rods from High Water, and inside the line of Low Water.**

LOCATION.	Area in Acres.	Total Area in Acres.
SALISBURY, . . . . .	. .	13
NEWBURYPORT, . . . . .	. .	232
Joppa Flats,	222	
Off Plum Island,	10	
IPSWICH, . . . . .	. .	96
South of Castle Neck,	53	
Off Castle Neck,	3	
Plum Island,	13	
South of Plum Island,	27	
ESSEX, . . . . .	. .	26
Vicinity of Hog Island,	26	
GLOUCESTER, . . . . .	. .	11
Off Twopenny Loaf,	9	
Squam River,	2	
NAHANT, . . . . .	. .	25
LYNN, . . . . .	. .	327
Large Shoal,	206	
Axes Point,	96	
Shoal,	25	

* This limitation does not apply to Provincetown, or any case where the Commonwealth owns the upland.

Flats Owned by Commonwealth—Continued.

LOCATION.	Area in Acres.	Total Area in Acres.
CHELSEA,	.	6
Off Pine's Point,	6	
BOSTON HARBOR,	.	1,722
Brewster Bar,	16	
East Boston,	444	
Chelsea Point,	44	
Breed's Island,	34	
Apple Island,	127	
Nick's Mate,	12	
Lower Middle,	4	
Governor's Island,	31	
Bird Island,	41	
Dorchester Bay,	44	
South Boston Flats,	925	
DUXBURY,	.	1,132
KINGSTON,	.	669
PLYMOUTH,	.	1,051
Inside Long Beach,	331	
Outside Pier Head,	47	
Off High Cliff,	592	
Clark's Island,	81	
BARNSTABLE,	.	99
South side of entrance,	17	
Off Sandy Neck,	53	
Thatcher Island Channel,	7	
South of Phill's Island,	8	
Great Creek,	14	
YARMOUTH,	.	598
DENNIS,	.	180
BREWSTER,	.	1,528
ORLEANS,	.	140
EASTHAM,	.	805
WELLFLEET,	.	118
Small Shoals,	41	
Off Beach Hill,	23	
Off Maya's Beach,	38	
Off Hatches Creek,	16	
TRURO,	.	13
Off Highlands,	9	
Cape Cod Bay,	4	

Flats Owned by Commonwealth—Concluded.

LOCATION.	Area in Acres.	Total Area in Acres.
PROVINCETOWN, . . . . .	. . . . .	1,260
Bay inside Race Point,	240	
Along N. W. Coast,	60	
Bay inside Wood End,	650	
Along S. Coast,	310	
CHATHAM, . . . . .	. . . . .	159
MONOMOY, . . . . .	. . . . .	530
Northerly end,	434	
Between Chatham and Monomoy,	96	
WAREHAM, . . . . .	. . . . .	28
Buttermilk Bay,	28	
EDGARTOWN, . . . . .	. . . . .	11
Skiff's Island,	11	
TISBURY, . . . . .	. . . . .	9
Lagoon Pond,	9	
Total amount of Flats owned by Commonwealth, . . . . .	. . . . .	10,788

EAST HARBOR.

Settlement has been made with the meadow owners at East Harbor during the year, the details of which are embodied in a report of the Board to the governor and council, which was approved by them, and is printed in the Appendix. The settlement was reached so near the end of the year, that a large number of the proprietors failed to deliver deeds in season, and it would be only equitable to renew the appropriation which lapsed with the fiscal year.

EDGARTOWN HARBOR AND COTAMY BEACH.

In their last annual report the Board presented the subject of Edgartown Harbor by a summary review of their action and coöperation in the steps that led to the appropriation by Congress for the much-desired improvement and protection of this important harbor. Extracts were also given from the report of Gen. G. K. Warren, who had charge of the engineering work.

The Board have since been informed by Gen. Warren that

the results of a survey, made since the date of his work upon Cotamy Beach, show no changes in the condition of the harbor since the survey by the United States Coast Survey in 1871, made at the request of this Board.

The Board intend to repeat this test by a still later comparative survey, which will be made as soon as practicable. They are fully sensible of the importance of protecting and improving this valuable harbor, and intend to take measures to secure, if possible, at an early day, such renewed action as may be found necessary in its behalf.

ICE OBSTRUCTION.

The severity of the winter of 1874-5 suggested to the Board the propriety of a systematic course of inquiry into the effects of ice as a cause of interruption of navigation, and of permanent injury or benefit to the channels of our harbors. Letters were addressed to the United States Revenue Collectors and other prominent citizens at the different ports, presenting questions which should serve as guides to them in arranging such information as they might feel disposed to furnish. These letters were responded to in most cases with fullness and apparent interest.

About the same time that the Board moved in this matter, the United States Coast Survey sent a special messenger along the coast to make similar inquiries, and at the request of this Board, the information thus obtained by the general government is promised as an addition to the data in hand.

It would be hardly safe to attempt to generalize and report results from this investigation till facts accumulate; but the immediate usefulness of this kind of information in determining upon the form and location of structures for which licenses may be asked, justifies the effort.

PROTECTION OF BEACHES.

The Board are frequently called upon to interfere to prevent the removal of gravel from beaches, where injury to harbors is feared from such removal. The powers of the Board are not, however, adequate for any efficient action in such cases; and the matter is deserving of attention, whether legislation may not be expedient for the better protection of beaches.

HARBOR-MASTER AT NEWBURYPORT.

Considerable complaint has been made to the Board of the removal of sand from Plum Island, in Newburyport Harbor, and of the obstruction of the harbor by vessels employed in such removal. The obstruction occasioned by the reckless anchoring of these vessels in the main channel is serious and dangerous; but the remedy lies, not in any action of this Board, but by the appointment of a harbor-master for that port, with adequate powers for the regulation of the anchorage of vessels.

LEGAL PROCEEDINGS.

Of the legal proceedings pending when the last annual report was made, those against the cities of Cambridge and Somerville are still before the courts. The information against the Boston & Lowell Railroad Corporation has been decided, the position of the Board being fully sustained. As this will be the leading case upon the points involved, and of great importance in the work of the Board, the opinion of Chief Justice Gray is printed entire.

Opinion of the Court.

GRAY, C. J. The colony ordinance of 1647, which is the source of private title in flats below high-water mark, provides that the proprietors “shall not by this liberty have power to stop or hinder the passage of boats or other vessels, in or through any sea, creeks or coves, to other men’s houses or lands.” (Anc. chart. 148, 149.) And it is within the authority of the legislature, for the benefit and security of public navigation, to regulate and restrain the building of wharves or other structures upon the flats under navigable waters, wherever the tide ebbs and flows. (*Commonwealth vs. Alger*, 7 Cush. 53; *Attorney-General vs. Woods*, 108 Mass. 436.) The legislature, perceiving the danger that any building upon or filling up of flats by private owners for their own advantage might, by diminishing the volume and changing the course of the tide-waters flowing in and out of the harbors, and the consequent increase of deposits, tend to choke up the channels and obstruct navigation, established, by Stat. of 1866, c. 149, a board of harbor commissioners, and, by sect. 2, intrusted to them “the general care and supervision of all the harbors and tide-waters, and of all the flats .

and lands flowed thereby, within the Commonwealth, except the Back Bay lands, so called, in the city of Boston, in order to prevent and remove unauthorized encroachments and causes of any kind which are liable to interfere with the full navigation of said harbors, or in any way injure their channels or cause any reduction of their tide-waters." By section 4, "all persons that have been or may be authorized by the legislature to build over tide-waters any bridge, wharf, pier or dam; or to fill any flats; or to drive any piles below high-water mark, who have not already begun such work, shall, before beginning it," give notice and submit plans of the proposed work to the harbor commissioners, and obtain their approval thereof in writing; and the harbor commissioners are to ascertain "the amount of tide-water displaced by any structure or filling hereafter authorized as aforesaid," and require the parties making the same to make compensation therefor, either by excavating in the same harbor to such an extent as may create a basin for as much tide-water as may be displaced by such structure or filling of flats, or by paying a sufficient sum of money for making such compensation, or by improving the harbor in any other mode to the satisfaction of the commissioners. By section 5, "all erections and works hereafter made without authority from the legislature, or in any manner not sanctioned by the board of harbor commissioners, where their direction is required as herein before provided, within tide-waters flowing into or through any harbor, shall be considered a public nuisance, and liable to indictment as such," or may be restrained by injunction at the suit of the attorney-general or other attorney of the Commonwealth, under the direction of the harbor commissioners.

It is under this statute that the present information has been filed. The respondent rests its defence upon two grounds: first, on an authority claimed under the statute of 1845, chapter 224; second, on having begun its work before the passage of the statute of 1866, chapter 149. But the court is of opinion that neither ground is tenable.

The statute of 1845 merely defined the boundary lines of the respondent's flats, and conferred no new title, right or authority upon the respondent.

When this information was filed, the extent of the flats which the respondent intended to fill up and build upon, had not been defined by any legislative Act, or by any line of wall or piles, but rested wholly in the knowledge and purposes of the respondent and its agents; and the case shows that the tide-water ebbed and flowed with no obstruction, except by a wall built along one side and about a fourth part of the front of the flats and then turning and running

back a short distance toward the upland, and there stopping, so that at the time of the filing of this information there was nothing to indicate the further direction of this sea-wall, or whether it was to run across the flats toward Austin Street or back to the upland, except so far as its course might be conjectured from the fact that piles had begun to be driven (to what extent does not appear) for a continuation of the proposed line now in question.

It cannot be deemed to have been the intention of the legislature that an undisclosed purpose, or even a plan upon paper, of work intended to be done, should be deemed a beginning of work within the meaning of the statute of 1866, chapters 149 and 155, and exempt the owner from the supervision of the harbor commissioners. It follows that the respondent, not having obtained the approval of the harbor commissioners of the proposed work, is subject to injunction.

COMPENSATION FUND FOR BOSTON HARBOR.

The following amount represents the Compensation Fund for Boston Harbor, up to January 1, 1876: \$130,504.33.

GOVERNMENT WORK BY THE UNITED STATES ENGINEERS IN BOSTON HARBOR AND ON THE EASTERN COAST OF MASSACHUSETTS.

By the courtesy of Gen. George Thom, of the United States Engineers, the Board have received a printed report upon the works under his charge in Massachusetts, with manuscript notes bringing it up to the date of the close of the working season of 1875.

As the annual reports of the United States Engineers cover the fiscal years of the general government, ending with the 30th of June, some of the matter contained in the last report of Gen. Thom has been already referred to in the ninth annual report of the Board, and therefore no reprint of his report, in full, is here appended.

The following extracts from Gen. Thom's last report include his special statements, for the benefit of the Board, of the work executed during the year 1875.

Merrimack River, including the Harbor of Newburyport.

In concluding his remarks upon this locality, Gen. Thom reports :—

“ It having been decided to apply the appropriation of March 3, 1875, to the removal of the shoals and sunken rocks, and otherwise improving the navigation of this river, so as to obtain a depth of not less than 12 feet at ordinary high water from its mouth to Haverhill, a contract was made May 19, 1875, with Messrs. Curtis, Fobes & Co., of Portland, Me., the lowest bidders, for 6,500 cubic yards, more or less, of dredging at Currier's Shoal (about four miles below Haverhill), at 35 cents per cubic yard, as measured in the scows, the work to be completed on or before December 1, 1875. For the removal of shoals and sunken bowlders scattered in the channel above and below Rock's Bridge (six and a half miles below Haverhill), as well as inside the draw of that bridge, a dredging-machine was employed from the 17th of May to the 9th of June, 1875, under authority of the department, whereby the channel has been greatly improved in this the most dangerous part of the river. Little Currier Rock has also been removed. This was a most dangerous sunken rock, lying in the main channel below and near Currier's Shoals. It had but seven feet of water over it at ordinary high water, and contained about ten cubic yards.

“ The amount available July 1, 1875, for the further improvement of this river, is \$13,163.55. This is to be applied to the following work for its improvement between Haverhill and Newburyport, viz. :—

1. 6,500 cubic yards' dredging at Currier's Shoal,	\$2,275 00
2. Removal of sunken rocks, say	1,000 00
3. Dike at Silby's Island,	8,750 00
Adding for contingencies, say	1,138 55
Total,	\$13,163 55

To complete all the improvements projected for this river will require the additional sum of \$27,000, as stated in my last annual report.”

Boston Harbor.

Straightening, Widening and Deepening the Main Ship-Channel at the West End of Great Brewster Spit.

Under our appropriation made by Act of June 23, 1874, work was resumed on the 11th of May, 1875, the earliest practicable, and was continued up to the close of the fiscal year, at which time 19,820 cubic yards had been dredged, whereby

the projected work was about two-fifths completed. The time for its completion was extended to the 15th of October, 1875. All the dredging called for under this contract was completed in August, 1875.

Straightening, Widening and Deepening the Main Ship-Channel at the South-east and South-west Points of Lovell's Island.

This work consists in the removal, by dredging, of the south-east and south-west points of this island, so as to give in the "Narrows" a channel 600 feet in width for a depth of 23 feet at mean low water, with proper slopes up to the 18-foot curve. Work was commenced on the south-west point in 1867, under a contract made with Mr. A. Boschké, of Boston, for dredging at 50 cents per cubic yard; and was continued during that and the two following years, until suspended for want of funds. A resurvey of this channel made in 1872, under my direction, showed that it had not changed to any considerable extent at its south-west point since the close of the dredging operations in 1869; that the 18-foot curve was very nearly the same as then; and that the shore above low-water line had acquired a more natural slope of eight feet horizontal to one foot rise by the receding inland of the high-water line, but that the flats off the *south-east* point of this island had advanced so much toward the main channel as to materially impede and endanger navigation.

Under the appropriation made by Act of June 23, 1874, for the improvement of Boston Harbor, a contract was made, September 8, 1874, with Messrs. Boynton Brothers, of Boston, the lowest responsible bidders, for completing the work projected for the improvement at the south-east point of this island; viz., 40,000 cubic yards, more or less, of dredging, at 38 cents per cubic yard, as measured in the scows. Work under this contract was commenced on the 7th of October, and continued until the 17th of December, 1874, when it was suspended for the winter. It was resumed on the 11th of May, 1875, the earliest date practicable, and was continued up to the close of the fiscal year, at which time 21,295 cubic yards of dredging had been done under this contract, whereby the projected work was about one-half completed.* The

* This contract was completed in September, 1875.

time for its completion has been extended to the 15th of October, 1875.

For completing the projected improvement at the southwest point of this island, about 40,000 cubic yards of additional dredging will be necessary, the estimated cost of which, at 40 cents per cubic yard, is \$16,000.

Straightening, Widening and Deepening the Main Ship-Channel at the Upper Middle Bar.

The work projected for the improvement of this bar consists in opening through it a channel 600 feet in width, to a depth of 23 feet at mean low-water, through a total distance of about 5,500 feet, the principal difficulties being in a space about 2,200 feet in length, in which the depth to be increased varies from one to seven feet. Under a contract made May 20, 1870, with Mr. Emory R. Seward, of Albany, N. Y., dredging was carried on at this place until the 1st of June, 1871, at which time 26,120 cubic yards had been excavated under that contract, by which one cut, about 1,800 feet in length, was partially opened to a width of 40 feet and to a depth varying from 20 to 23 feet at mean low water.

Under the appropriation made by Act of March 3, 1871, a new contract was made July 29, 1871, with Mr. R. G. Packard, of Brooklyn, N. Y., which was completed June 29, 1872, by 20,305 cubic yards of dredging, making, to that date, an aggregate of 46,425 cubic yards of dredging. By this work, one cut, about 1,800 feet in length, was opened to a width of 40 feet, to a full depth of 23 feet at mean low-water, and a second cut of the same width and depth for a length of 1,040 feet, including the removal of a very large boulder, discovered in 1872, in the main ship-channel, with but 16½ feet of water upon it at mean low water.

Under the appropriation of March 3, 1873, a contract was made March 5, 1874, with the Atlantic Dredging Company, of Brooklyn, N. Y., for 75,000 cubic yards, more or less, of dredging, at 64 cents per cubic yard, as measured in the scows; and at \$35 per cubic yard for excavation of ledge and of boulders exceeding six tons in weight. Operations were commenced in April, 1874, and up to the 1st of July of that year, 8,476 cubic yards of dredging had been done under this

contract. These operations were continued up to the 14th of December, 1874, when they were suspended for the winter. On the 26th of May, 1875, they were resumed, and continued up to the close of the fiscal year (June 30, 1875), at which time 39,615 cubic yards had been dredged under this contract.

Under the appropriation made by Act of June 23, 1874, for continuing the improvement of this harbor, a contract was made, September 1, 1874, with the Harbor Improvement Company of Boston, for 42,000 cubic yards of additional dredging on this bar, at 85 cents per cubic yard, as measured in the scows. Dredging was commenced under this contract on the 3d of October, and continued until the 14th of December, 1874, when it was suspended for the winter. It was resumed on the 8th of May, 1875, and continued up to the end of the fiscal year (June 30, 1875), at which time 13,140 cubic yards had been dredged under this contract.

The total quantity of dredging, therefore, that has been done up to this date under the several contracts named, amounts to 99,180 cubic yards; whereby a channel has been opened for an average width of 240 feet, and a depth of 23 feet at mean low water through the shoalest portion of the Upper Middle Bar, averaging in length about 2,200 feet.*

Under the appropriation made for this harbor by Act of March 3, 1875, a contract was made May 19, 1875, with Messrs. Curtis, Fobes & Co., of Portland, Me., for 90,000 cubic yards, more or less, of additional dredging on this bar, and the shoals below it, at 75 cents per cubic yard, as measured in the scows, including bowlders not exceeding six tons in weight; and for excavating ledge, or bowlders exceeding six tons in weight, at \$35 per cubic yard,—the work to be commenced on or before the 1st of October, 1875, and to be completed on or before the 30th of September, 1876.

In order to complete the projected channel at the Upper Middle Bar, it will be necessary to provide for about 25,000 cubic yards of dredging, in addition to that which remains to

* On the 1st of January, 1876, this channel was opened for a width of about 500 feet, in which, for a width of about 360 feet, the full depth of 23 feet at mean low water was obtained, the remaining portion having still some shoal places to be deepened.

be done under the three unfinished contracts, the estimated cost of which, at 75 cents per cubic yard, is \$18,750.

Removal of Nash's Rock.

Under the appropriation made by Act of March 3, 1875, for the improvement of this harbor, a contract was made May 19, 1875, with Messrs. Curtis, Fobes & Co., of Portland, Me., for the removal of this shoal to the projected depth of 21 feet at mean low water, on terms as follows; viz., for 200 cubic yards, more or less, of gravel, shingle, etc., including bowlders not exceeding six tons in weight, at \$5 per cubic yard, as measured in the scows, and for bowlders exceeding six tons in weight (of 2,240 pounds) at \$35 per ton.

This work is to be commenced on or before the 1st of October, 1875, and to be completed on or before the 30th of September, 1876.

Completing the Removal of Kelly's Rock.

Under the appropriation made by Act of March 3, 1875, for this harbor, a contract was made May 14, 1875, with Mr. George W. Townsend, of Boston, for completing the removal of this rock, at \$60 per cubic yard, on or before the 30th of September, 1875. He commenced operations under this contract in the latter part of May, and in September, 1875, the removal of this rock to a depth of 23 feet at mean low water was completed.

Removal of Slate and Palmyra Rocks.

The work of removing these rocks was resumed by Mr. Wm. H. Lloyd, of Boston, under former contract, about the 1st of June, 1875, and completed on the 15th of that month.

Hingham Harbor.

By Act of Congress of March 3, 1875, provision was made for the improvement of Hingham Harbor, to an extent not to exceed \$10,000. A careful survey of this harbor, made in October and November, 1874, showed the nature and extent of the improvements required for the commerce of the place, the project for which consists in widening and deepening the channel so as to have a width of not less than 100 feet and a

depth of eight feet at mean low water, or about six feet at low water of spring tides. For this improvement, the following work is required :

Fourteen thousand cubic yards of dredging and 100 cubic yards of ledge excavation will make the cost about \$7,000.

These improvements were nearly completed in December, 1875.

Financial Statement.

Balance in Treasury of United States, July 1,	
1874,	\$110,442 15
Amount in hands of officer, and subject to his	
check, including \$11,011.89, percentage due	
on contracts not yet completed, July 1,	
1874,	52,280 44
Amount appropriated by Act of March 3, 1875,	100,000 00
Amount expended during fiscal year, ending	
June 30, 1875,	69,791 81
Amount available, July 1, 1875, including	
\$10,572.14 due on contracts,	192,930 78
Amount required for the fiscal year, ending	
June 30, 1867,	60,000 00

Improvement of Plymouth Harbor.

Operations were resumed upon Long Beach in June, 1875, and during that month the work done was as follows ; viz., 504 tons of small bowlders have been delivered, and the greater part of them placed on the outer stone bulkhead on Long Beach, whereby its efficiency has been much increased. Some have also been used in the repairs and extension of some of the groins. Brush-groins have also been built on the inside of the bulkhead, and beach-grass has been planted where most necessary. The work projected for the repairs and preservation of the improvements on Long Beach has thereby been nearly completed for this season.

With a view to improving the channel leading from the Middle Ground up to Long Wharf in Plymouth, a survey was made in February, 1874, from which it was estimated that 64,000 cubic yards of dredging would be necessary to excavate the channel for a width of 100 feet, for a depth of six feet at mean low water, giving 16.1 at mean high water.

Under the appropriation of \$10,000, of March 3, 1875, a contract was made May 13, 1875, for 35,000 cubic yards, more or less, of dredging, to be applied to the partial excavation of the proposed channel.

Amount required for the fiscal year ending June 30, 1877, \$10,000.

Improvement of Provincetown Harbor.

The amount expended for the preservation and improvement of this harbor during the fiscal year ending June 30, 1875, is \$7,777.41.

This expenditure has been applied to the work as follows, viz. :—

1. Building a bulkhead and six jetties for the preservation and protection of the beach at Cove Section, near High Head, where encroached upon by the extraordinary gales of November, 1873, and January, 1874. This bulkhead is 607 feet in length, and the jetties have an aggregate length of 126 feet. They consist of a framework filled with brush, and ballasted with stone; and since their completion in December, 1874, their efficiency has been most successfully tested by a violent storm, which washed over the beach and filled the space in front of the work to the depth of two to three feet with sand, adding greatly to its strength.

2. Extending and raising the stone bulkhead for the protection and preservation of Long Point, in front of the lighthouse, and the Three-gun Battery. For this work, 1,518 tons of stone have been purchased and placed in position since July last.

3. Repairs of bulkhead and jetties, and building groins on Beach Point; repairs of dikes at High Head and Abel Hill; and planting beach-grass on Beach Point and Cove Section.

4. At High Head a new sluice has been partially built through the dike, in place of the dilapidated wooden one, whereby the dike will be much strengthened at this heretofore its weakest place.

For this sluice a cement 15-inch pipe is used, having at its head an iron gate set into a concrete and brick wall. This dike has also been otherwise repaired where necessary.

The unexpended balance available for the improvement of

this harbor, July 1, 1875 (including the sum of \$5,000, appropriated by Act of March 3, 1875), is \$3,326.07, which is sufficient to provide for the objects for which the estimates have hitherto been submitted. But for continuing these works there will be required the additional sum of \$5,000 for the fiscal year ending June 30, 1877, viz. :—

1. Raising and extending the stone bulkhead for the protection and preservation of Long Point, near the light-house, and Three-gun Battery, . . .	\$2,000 00
2. Repairs of bulkhead and jetties on Beach Point and Cove Section,	750 00
3. Repairs of dikes at High Head and Abel Hill, . . .	250 00
4. Planting beach-grass for preserving and strengthening the "outer beach,"	500 00
Adding for contingencies, say	1,500 00
	<hr/>
Total,	\$5,000 00

GOVERNMENT WORK BY THE UNITED STATES ENGINEERS ON THE SOUTHERN COAST OF MASSACHUSETTS.

By the courtesy of Gen. G. K. Warren, of the United States Engineers, the Board have received printed copies of his report to the chief of engineers, of the works under his charge in Massachusetts; from which, as in the case of the report of Gen. George Thom, extracts only have been made.

Gen. Warren is executing very interesting and important work in the Connecticut River, within the borders of the State; but as these waters do not come under the jurisdiction of the Board, no comments upon them are appropriate to this report.

Hyannis Breakwater.

An appropriation of \$5,000 was made by Act of 23d June, 1874, and has been expended in building out the slope of this breakwater below water. To strengthen this work so that it will withstand the severe storms to which it is exposed, will cost, according to Gen. Warren's estimate, about \$10,000. This he recommends. He also, again, advises the removal of the light-house to the east end of the breakwater. The following statement is made concerning this work.

The breakwater for the protection of Hyannis Harbor was

begun in 1828, and continued with few interruptions until 1837, \$70,931.82 having been expended in this time. In January, 1853, an appropriation of \$5,000 was expended; in 1870, \$12,000, under Gen. J. G. Foster; and in 1871, \$10,000, under Gen. George Thom. In July, 1872, the work was transferred to Gen. G. K. Warren, and in 1873, \$10,000 more were appropriated, and have been expended mainly in repairing and strengthening the structure. This work will cost, when completed, including the \$10,000 recommended by Gen. Warren, about \$118,000.

Edgartown Harbor.

A survey of the entrance to Edgartown Harbor was made in August, 1874, with the unexpended balance of the appropriation of \$20,000 for opening a southern outlet to the harbor through Cotamy Beach (about \$1,375). Gen. Warren reports no change in the condition of the harbor since the survey of the United States Coast Survey in 1871, and recommends no further appropriation.

Wareham River.

With the \$10,000 appropriated in June, 1874, the channel around the upper bar has been dredged to a depth of nine feet at mean low water, and to a least width of 100 feet. The improvement of this harbor will be completed with the appropriation of March 3, 1875, and nothing further is recommended.

Taunton River.

During the past year the channel through the upper shoals was about completed. With the appropriation of March 3, 1875, of \$10,000, it is proposed to dredge, and remove rocks; namely, from the lower part of the river and the wider channel. To insure the completion of this work, an appropriation of \$5,000 is recommended for the fiscal year ending June 30, 1877.

Fall River Harbor.

During the past year bowlders have been removed from the proposed channel to the wharves. Two appropriations of \$10,000 each have already been made, which, with a deduc-

tion of \$5,000 from the original estimate, leaves \$20,000 more needed to complete the improvement.

New Bedford Harbor.

A survey of this harbor has been made, which has resulted in a plan of improvement estimated to cost \$24,000. In March, 1875, an appropriation of \$10,000 was made, which will be expended in dredging during the present season. The sum of \$14,000 is recommended for the next fiscal year.

OFFICE WORK.

The business of the office steadily increases, and during the past year a greater amount of work has been executed than usual. Notwithstanding the depressed state of business generally, the applications for licenses have been in excess of those of any previous year. The number of plans approved and licenses issued by the Board have amounted to sixty-three. In acting upon the subjects submitted to them for consideration, the Board have visited the localities, and examinations and surveys have been made whenever proposed work required it.

The following statistics show the particulars of work done :—

Plans approved by the Board of Harbor Commissioners during the year 1875, for the erection of structures in or over tide-water, and licenses granted for such structures.

1. David G. Allen, for leave to extend his wharf in Gloucester. Approved January 6, 1875.

2. City of Boston, for leave to change the grade in Eastern Avenue Bridge. Approved January 11, 1875.

3. Harvey Scudder et als., for leave to build a pile wharf in Osterville. Approved January 20, 1875.

4. George Clark, Jr., and John E. Somes, for leave to fill the dock between their wharves. Approved January 20, 1875.

5. John Pickett, for leave to extend his wharf at Beverly. Approved January 27, 1875.

6. The heirs of William McKenzie, for leave to extend their wharf in Gloucester Harbor. Approved February 3, 1875.

7. Brookline Gas Company, for leave to build a wharf in Charles River. Approved February 10, 1875.

8. Boston & Maine Railroad Co., for leave to strengthen the draw in its bridge over Miller's River. Approved February 24, 1875.

9. Daniel W. Stevens, for leave to widen his wharf at Vineyard Haven. Approved March 3, 1875.

10. Trustees of the Boston College, for leave to construct a wharf at Fairhaven. Approved March 24, 1875.

11. Charles R. Clark, for leave to extend his wharf in South River, Salem Harbor. Approved March 31, 1875.

12. Commissioners on West Boston and Cragie bridges, for leave to widen the drawways on West Boston Bridge. Approved April 14, 1875.

13. The Boston, Revere Beach & Lynn Railroad Co., for leave to build a wharf in East Boston. Approved April 21, 1875.

14. Boston, Revere Beach & Lynn Railroad Co., for leave to build a drawbridge across Saugus River. Approved April 21, 1875.

15. Henry O. Houghton and others, for leave to build a sea-wall and do certain filling in Charles River, Cambridge. Approved April 21, 1875.

16. George H. Walcott, for leave to construct a pile pier at South Boston Point. Approved May 5, 1875.

17. James Mansfield and Sons, for leave to extend their wharves to the commissioners' line, Gloucester Harbor. Approved June 15, 1875.

18. Proprietors of Rowe's Wharf, for leave to extend to the harbor line. Approved May 5, 1875.

19. Jonathan Cook, for leave to build a pile wharf in Provincetown. Approved May 5, 1875.

20. William C. Turner, for leave to extend his wharf in Scituate Harbor. Approved May 12, 1875.

21. Old Colony Railroad Co., for leave to widen the draw-opening in their bridge across Taunton River, at Fall River, and make other changes. Approved May 19, 1875.

22. Clark and Somes, for leave to extend their wharf to the harbor line in Gloucester Harbor. Approved May 26, 1875.

23. John E. Somes, for leave to extend his wharf to the harbor line in Gloucester Harbor. Approved May 26, 1875.

24. David G. Allen, for leave to extend his wharf to the harbor line in Gloucester Harbor. Approved May 26, 1875.

25. Henry Campbell and Charles A. Campbell, for leave to extend their wharf in Chelsea. Approved May 26, 1875.

26. The Butchers' Slaughtering and Melting Association, for leave to extend its wharf in Charles River. Approved May 27, 1875.

27. Caleb H. Dolbeare, for leave to extend Dolbeare's wharf on Broad Street, Fort Point Channel. Approved June 2, 1875.

28. Eastern Railroad Company, for leave to widen its wharf and bridge over Charles River, on the Boston side. Approved June 2, 1875.

29. City of Newburyport, for leave to rebuild part of its bridge and draw-pier in Merrimack River. Approved June 2, 1875.

30. Boston, Revere Beach & Lynn Railroad Co., for leave to build a bridge across Sales Creek, in Revere. Approved June 23, 1875.

31. Boston, Revere Beach & Lynn Railroad Co., for leave to build a pile wharf and ferry-slip between Rowe's and Foster's wharves. Approved June 26, 1875.

32. City of Boston, for leave to rebuild the draw and draw-pier on Meridian Street Bridge. Approved June 26, 1875.

33. Boston, Revere Beach & Lynn Railroad Co., for leave to build temporary bridges over such water spaces and flats as are crossed by the line of its railroad between East Boston and Lynn. Approved June 26, 1875.

34. Jonathan Cook, for leave to build a pile wharf in Provincetown Harbor. Approved June 30, 1875.

35. City of Boston, for leave to build a pile wharf at Rainsford Island, Boston Harbor. Approved July 7, 1875.

36. City of Boston, for leave to rebuild Malden Bridge, over Mystic River. Approved July 14, 1875.

37. Old Colony Railroad Co., for leave to extend its wharf in Fort Point Channel fifty feet. Approved July 7, 1875.

38. Parmenter, Rice & Co., for leave to extend Battery Wharf to the harbor line in Gloucester Harbor. Approved August 4, 1875.

39. Butchers' Slaughtering and Melting Association, for leave to build a pile structure in Charles River, near Arsenal Street Bridge. Approved August 25, 1875.

40. D. D. and A. W. Chase, for leave to extend their wharf in Merrimack River, Haverhill. Approved September 1, 1875.

41. James Damon, for leave to extend his wharf in Ipswich River. Approved September 1, 1875.

42. William G. Brown, for leave to extend his wharf in Ipswich River. Approved September 1, 1875.

43. Alfred Cook, for leave to extend his wharf in Provincetown harbor. Approved September 8, 1875.

44. Daniel Small, for leave to build a pile wharf in Provincetown Harbor. Approved September 8, 1875.

45. South Boston Gas-Light Co., for leave to extend its wharf at South Boston. Approved September 15, 1875.

46. J. Wingate Thornton, for leave to build a wharf at Winthrop. Approved September 15, 1875.

47. City of Boston, for leave to rebuild the berth of the city

steamboat on Eastern Avenue Wharf. Approved November 3, 1875.

48. Warren Averill, for leave to extend his wharf in Ipswich River. Approved October 6, 1875.

49. City of Boston, for leave to build an addition to the steamboat wharf at Deer Island. Approved September 29, 1875.

50. D. D. and A. W. Chase, for leave to extend their wharf in Merrimack River, Haverhill. Approved October 13, 1875.

51. George W. Duncan et als., for leave to extend his wharf in Merrimack River, Haverhill. Approved October 13, 1875.

52. Edward S. Rand, for leave to drive piles in a dock on the westerly side of Charles Street, opposite Poplar Street. Approved October 20, 1875.

53. Fitchburg Railroad Company, for leave to extend its wharf in Charles River, on the Charlestown side. Approved October 27, 1875.

54. Pierce and Canterbury, for leave to extend their wharf in Chelsea Creek on piles. Approved October 28, 1875.

55. City of Boston, for leave to rebuild Commercial Point or Tenean Bridge, in Ward 16, Boston. Approved November 3, 1875.

56. Daniel W. Fuller, for leave to build a wharf at Magnolia Village, Gloucester. Approved November 17, 1875.

57. John McKinnon, for leave to build a wharf at Breed's Island, rear Winthrop Bridge, Boston. Approved November 17, 1875.

58. George Norwood & Son, for leave to extend their wharf in Gloucester Harbor. Approved November 17, 1875.

59. Laban Pratt, for leave to extend his wharf at Oak Bluffs, Martha's Vineyard. Approved November 24, 1875.

60. Shute & Merchant, for leave to extend their wharves in Gloucester Harbor. Approved December 1, 1875.

61. James J. and Horatio D. Jarvis, for leave to refill a portion of their wharf at South Boston. Approved December 1, 1875.

62. Boston Boat Club, for leave to maintain a floating boat-house in Charles River. Approved December 8, 1875.

63. City of Boston, for leave to drive additional piles in the southerly end of the draw-pier in Congress Street (formerly Eastern Avenue) Bridge. Approved December 29, 1875.

Hearings before the Board in addition to the regular Business Meetings.

One hearing with the Boston Wharf Company in regard to the grade of Eastern Avenue Bridge.

One hearing with the selectmen of Westport in regard to a new bridge between Westport Point and Horse Neck Beach.

One hearing with citizens of Sandwich in relation to the bridge of the Old Colony Railroad Company across Monument River.

Two hearings with land-owners at East Harbor, Provincetown, in relation to damages done to the meadows by the construction of the dike across East Harbor.

One hearing, according to advertisement, on the petition of the Boston & Maine Railroad Company for leave to discontinue the draw in its bridge over Miller's River.

One hearing with the contractors on South Boston Flats in regard to extension of time of contract.

Two hearings on the petition of Charles S. Clark, for leave to extend his wharf in South River, Salem Harbor.

Two hearings on the petition of the Boston, Revere Beach & Lynn Railroad Company, for leave to construct a drawbridge over Saugus River or over sundry creeks along its road between Boston and Lynn.

One hearing with owners of wharves near Chelsea Ferry, in regard to the dredging of Junction Shoals, under chapter 304 of the Acts of 1874.

Two hearings on the petition of Harvey T. Litchfield et als., for leave to extend Litchfield's Wharf, on Broad Street, to the harbor line.

One hearing with the proprietors of Dolbeare's and Otis's wharves in regard to maintaining illegal structures in tide-water in Fort Point Channel.

Three hearings on the petition of the city of Newburyport for leave to reconstruct its bridge across Merrimack River.

Four hearings on the petition of the Cambridge Improvement Company, for leave to construct a bridge across Broad Canal in the extension of First Street, Cambridge.

One hearing on the petition of Herbert B. Newhall and others, praying that the draw in the bridge across Saugus River in Western Avenue at Lynn be widened to 33 feet.

Two hearings on the petition of D. D. and A. W. Chase, for leave to extend a wharf in Merrimack River at Haverhill.

One hearing on the petition of David W. Fuller, for leave to construct a wharf in Magnolia River, Gloucester.

One hearing on the petition of Charles Parkhurst, for leave to extend his wharf in Gloucester to the harbor line.

One hearing with Committee on Harbors of the city of Boston in relation to a dumping place of the material dredged from Roxbury Canal.

One hearing with wharf-owners at South Boston in relation to dumping material on Commonwealth's flats, purchased from riparian owners.

One hearing on the petition of James Damon, for leave to extend his wharf in Ipswich River, Ipswich.

One hearing on the petition of the selectmen of Medford, for leave to build a level bridge, without a draw, across Mystic River in Main Street, Medford.

One hearing on the petition of the Plymouth County Railroad, for leave to build bridges across Weymouth, Fore, and Back rivers.

Two hearings with Chelsea Ferry Company in regard to stopping the ferry for a short time to allow the contractors for dredging Junction Shoals to dredge in the line of the ferry.

Two hearings on the petition of William L. Bradley, for leave to extend his wharf at Pine Island, South Bay.

One hearing on the petition of Laban Pratt, for leave to extend his wharf at Oak Bluffs, Martha's Vineyard.

One meeting with the agents of the Commonwealth's flats at South Boston.

One hearing with the parties engaged in illegal filling of flats in Prison Point Bay, Charlestown.

Two hearings on the petition of the South Cove Corporation, and George W. Tuxbury and others, for leave to fill flats, etc., in South Bay.

One hearing on the petition of the Boston Boat Club, for leave to place a floating boat-house on Charles River.

Three hearings on the petition of Churchill and others, for the removal of shoal in Green Harbor River.

One hearing with the Park Commissioners of the city of Boston.

Plans and Surveys.

Survey in Salem for the purpose of wharf extension by Charles S. Clark, in South River, and made plan thereof.

Survey in Charles River, Brighton, to establish low-water mark, for the purpose of wharf extension by the Butchers' Slaughtering and Melting Association.

Survey in East Boston to establish low-water mark in front of the wharf built by the Boston, Revere Beach & Lynn Railroad Company.

Survey and inspection of the drawbridge over Saugus River in Western Avenue, Lynn.

Survey and visit to Kettle Cove, Magnolia, for the purpose of wharf extension by David W. Fuller.

Survey in Merrimack River, Haverhill, for the purpose of wharf extension by D. D. and A. W. Chase.

Survey in Ipswich River for the purpose of wharf extension by James Damon, Wm. G. Brown and Warren Averill.

Survey of Prison Point Bay to ascertain the amount of illegal filling done by sundry parties in said bay, and plan made thereof.

Three surveys of dredging-ground in front of Chelsea Ferry, to ascertain amount of material gone by contract with Charles H. Lewis, and plans made thereof.

Inspection of dumping-ground in Salem and Marblehead harbors for Philadelphia and Reading Coal and Iron Company.

Survey to establish low-water mark in Chelsea Creek for the purpose of wharf extension by Pierce and Canterbury.

Survey at Deer Island for the purpose of selecting a place where gravel can be taken, without injury to the island and harbor, and plan made thereof.

Inspection of the draw and draw-piers in the bridge across Merrimack River, at Haverhill.

Survey in South Bay for the purpose of wharf extension by Wm. L. Bradley, and plan made thereof.

Survey and inspection of the draw-pier in the Newburyport Bridge across Merrimack River.

Survey in front of the National Docks, at East Boston, to ascertain amount of shoaling, and plan made thereof.

Survey of Menemsha Bight for the purpose of improving the inlet to Menemsha Pond, in accordance with chapter 10 of the Resolves of 1875.

This Board have been long fortunate in the coöperation of Prof. Whiting, of the Coast Survey, and of Prof. Mitchell, of the United States Advisory Council, to whose special culture and scientific attainments is due much of the credit for what has been accomplished by the Board. In presenting a summary of the work of the past year, acknowledgment of their services is due. The Board have also to acknowledge courtesies from the Superintendent of the Coast Survey.

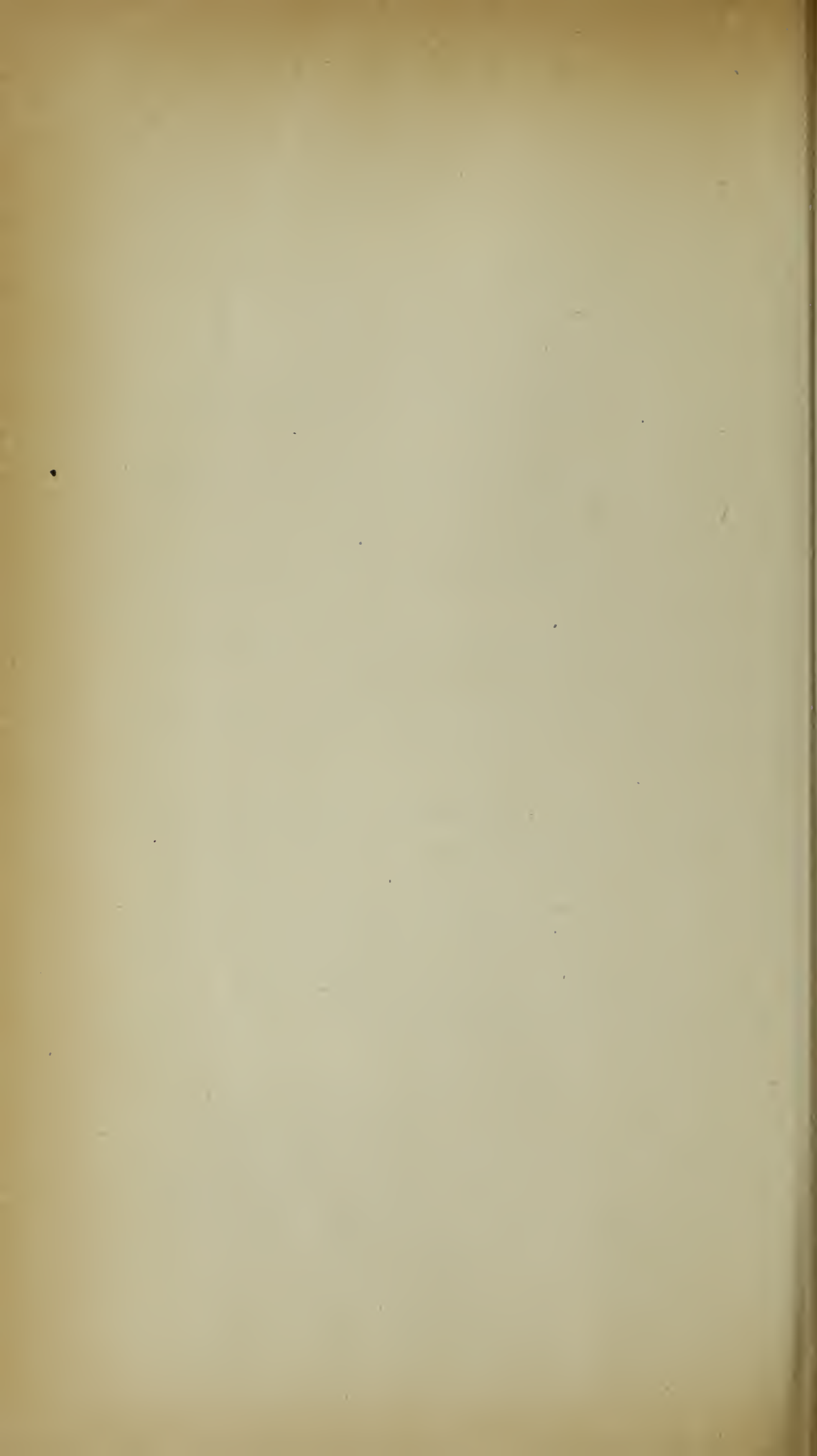
JOSIAH QUINCY.

F. W. LINCOLN.

J. N. MARSHALL.

WM. T. GRAMMER.

ALBERT MASON.



A P P E N D I X.

a mortar of uniform character and undoubted strength, but have also got a *quick-setting* cement, so that the mortar which was laid between tides was not liable to be washed out at high water.

The ballast for backing this heavy wall is of clean gravel, dredged from the bars and spits adjacent to the islands of the harbor, consisting of pebble-stones from the size of a man's fist down to a coarse sand, generally well mixed. This has been floated into place and dumped from scows in the rear of the wall for a depth of 28 feet for a length of 575 feet, and at a lesser depth for a further length of 150 feet. It is spread out in the rear to a width of two or three times its height, under the action of the waves, requiring a considerable quantity of material to bring it up to the top of the wall. In order to economize a part of this material, the sub-contractor for the filling and ballasting now proposes to use oyster-shells for the upper eight or ten feet, which will stand at a much steeper slope than the gravel. This quality, as well as their lightness, renders the shells a better material for the stability of the work, by throwing less strain upon the wall.

The work of filling had been temporarily suspended at the beginning of the year, by lack of apparatus for lifting the material over the wall. Such apparatus having been supplied by the contractor early in March, the work of filling was then resumed in the following manner: The clay was first dredged from the harbor and brought up to the front of the light wall in scows, where it was dumped. Another dredge, which was here provided, hoisted the clay over the wall, swung it around, and dumped it on a sloping platform, in the rear of the wall, which was laid on the ballast. It was at first attempted to dump it directly upon the ballast of broken stone; but it was found that, in sliding down, the clay displaced the ballast, so that a platform was put in to protect it.

A few weeks sufficed to exhaust this dumping-ground, by filling most of the nearer portion of the flats up to grade 13 for nearly the whole length of the light wall, or as far as this was ballasted and ready to receive the filling.

In order to deposit clay on the remainder of the space, further apparatus was needed; viz., a trestle-work of piles, running back over the flats to be filled, with a locomotive and cars of a narrow gauge to receive the clay from the dredge which lifts it over the wall, and thence to distribute it where it was wanted. This apparatus having been prepared, the filling was resumed in June last, since which it has proceeded as rapidly as was consistent with the limited space between the wall and the site for the first dock. The repeated handling of the clay, as above described, reduced it to a

mortar, so that when dumped from the cars on the trestle, it spread out at a very flat slope, some 10 to 15 feet for every foot of height, requiring a very broad area. It therefore soon became evident that no large amount of filling could be done until the dock wall should be built up to limit its spreading. Hence arose the immediate need of providing for the construction of this dock. The contract of June 23, 1875, was executed to meet this exigency, and work was at once begun under this contract by dredging the foundation trench and driving piles for the dock wall. The piles have now been driven for the whole length of the west side of the dock, across its head, and for some 300 feet of the east side. The specification for this wall was similar to that for the wall on Fort Point Channel. Although several hundred feet of the foundation has been prepared, no great progress has been made in laying the stone. The lower course is to be laid just below low water, so the work can only be done at extreme low water of spring tides. These tides during the autumn months were accompanied by strong easterly winds, which prevented the ebb tides from reaching a point which would allow much work to be done.

The quantities and value of the work done under these contracts from the beginning, those done during the past year, and now remaining to be done, are shown in the following statement:—

	LINEAL FEET.		Square feet filling.	Total value.	Reserved under contract.	Actual payments.
	Light wall.	Heavy wall.				
Work done,—						
Previous to January 1, 1875,	641	255	190,016	\$160,139 00	\$16,013 88	\$144,125 12
During 1875,	497	488	159,200	197,543 26	19,754 32	177,788 94
Total to January 1, 1876,	1,138	743	349,216	357,682 26	35,768 20	321,914 06
Total when complete,	2,580	947	846,000	700,435 00	—	—
Remaining to be done,	1,442	204	496,784	342,752 74	—	—

It thus appears that while work has been done valued

at the sum of \$357,682 26

There has been reserved, under the terms of the contract, the sum of

\$35,768 20

If we add this reserve to the value of work yet

remaining to be done; viz., 342,752 74

We have the sum of \$378,520 94

Yet to be paid under the existing contracts, besides

a proper allowance for superintendence and con-

tingent expenses, say 20,000 00

Making a total of \$398,520 94

The dimensions of the dock provided for are shown upon the accompanying diagram.

A platform of oak piles is to be made along the face of the wall, though not included in the existing contracts or the above estimates, similar to the one along the wall on Fort Point Channel. The object of this platform is to provide width for the slope of the clay between the deep water of the berths in front of the platform and the top of the piling under the wall, which is only two feet below low water at spring tides.

As this slope near the mouth of the dock is more exposed to the erosion of waves and currents than it is further up the dock, the clay could not be depended upon to stand at so steep a slope as to allow a platform of twenty feet in width to suffice. The line of the wall is therefore deflected back, so as to allow a width of forty feet for the platform near the mouth of the dock, without encroaching upon the width of the dock itself. To protect this sloping surface under the platform from erosion, a covering of quarry chips and refuse is to be applied to it near the mouth of the dock. If the platform had been limited to a width of twenty feet at this end, and the dock walls built straight, it would have been necessary to start the foundation of these walls several feet deeper; and as the stone could not have been so laid without submarine divers, such a plan would have largely increased the cost, without adding to the stability of the permanent work. The greater width of platform here adopted is an increase of the amount of work subject to renewals, but does not affect the permanent portions of the work, except as above stated.

The widening of the platform, or rather the setting back of the dock walls on each side of the pier-head between the first and second docks, modifies favorably the conditions affecting the heavy wall forming this pier-head, by diminishing the width of the filling

which this wall will have to retain from 156 feet to about 116 feet of its length, thus limiting the filling to about two-thirds of its whole length, while the two dock walls being bonded into the heavy wall at their intersections, nearly at right angles with one another, add materially to its stability. These conditions tended to remove some of the doubts which I had before entertained as to the stability of the wall of dimension-stone without a broad base of rip-rap, though this had first been proposed by Gen. Foster and others, while the following reason appeared as an objection to the use of rip-rap at this point; viz., the exposure of the foundation to the impact and disturbing force of the waves in a storm would be greater at this point than further west.

It therefore seemed advisable to abandon the broad rip-rap foundation for this pier-head, and to fall back upon the style of wall formerly contemplated, by starting the cut-stone work at the bottom, 23 feet below low water, and 18 feet thick; also to build the wall plumb on the back with the whole batter in front.

But previous to determining to advise this style of wall at this place, I caused experiments to be made upon the ground where it was to stand, with the view of learning what amount of resistance could be relied upon by the very material on which the wall was to be laid up. Without such facts, we should have been working rather in the dark. A description of these experiments may be of interest.*

The dredging having been completed along the whole length of the proposed pier-head to the required depth of 23 feet below low water, piles were driven at intervals, in order to learn what degree of uniformity existed in the general character of the bottom. The dredging and pile-driving both tended to show a great uniformity in the physical characteristics of the bottom along the whole length of the work. It was a firm though fine clay, yet soft enough to allow of piles being driven into it with ease. Selecting a central point for the experiment, a group of piles were driven into it and fastened together at the top, where a small platform was built on them. A single pile, with squarely-sawed point, was set upright, resting its point on the clay, while its top was held vertically over its lower end by the platform, through a hole in which it was allowed to slide. A small cross-head was then made fast to the top of this loose pile, on which definite weights were applied, while the amount of settlement under these weights was observed by a levelling instrument and referred to a fixed bench-mark.

The results were as follows:—

The figures under the head of “settlement” indicate the new or additional subsidence due to the increase of load.

* The writer is indebted to Mr. Jos. P. Frizell for conducting these experiments, with Mr. J. O. Osgood, your inspector.

Total weight in pounds.	Pounds per square foot.	Settlement in feet.	Interval during which settle-ment occurred.
670	2,921	0.03	17 hours.
1,300	5,668	0.06	7½ hours.
2,500	10,900	0.04	At once.
2,500	10,900	0.05*	16 hours.
2,830	16,700	0.04	At once.
2,830	16,700	0.20*	7 hours.
2,830	16,700	0.25*	21 hours more.
2,830	16,700	0.00*	72 hours more.
2,830	16,700	0.03*	72 hours more.
2,830	16,700	0.025*	¼ hour more.

* Additional.

In order to show the amount of resistance offered by this material to the penetration of square-pointed piles under the hammer, I give below a statement of the successive penetration of several piles here driven. The hammer weighed 1,385 pounds. The piles were selected of about the same size; viz., 6½ inches diameter at the point. They varied from 43 to 53 feet in length. The water was about deep enough to float the piles as they stood upright before being driven.

				Blow.	Fall of hammer.	Penetration.
Platform piles.	{	First pile,		1st.	8 ft.	7½ inches.
		“		2d.	8 ft. 7½ in.	6 “
		“		3d.	9 ft. 1½ in.	5½ “
	{	Second pile,		1st.	7 ft. 2 in.	8 “
		“		2d.	7 ft. 10 in.	6 “
		“		3d.	8 ft. 4 in.	7½ “
	{	Third pile,		1st.	7 ft. 6 in.	6¾ “
		“		2d.	8 ft. ¾ in.	7¼ “
		“		3d.	8 ft. 8 in.	7½ “
	{	Fourth pile,		1st.	6 ft.	7 “
		“		2d.	6 ft. 7 in.	7 “
		“		3d.	7 ft. 2 in.	9½ “
	{	Fifth pile,		1st.	6 ft. 6 in.	7¼ “
		“		2d.	7 ft. 1¼ in.	7 “
		“		3d.	7 ft. 8¼ in.	8¾ “
	{	Sixth pile,		1st.	7 ft. 7½ in.	8¾ “
		“		2d.	8 ft. 4¾ in.	11½ “
		“		3d.	9 ft. 3½ in.	11¾ “
	{	Seventh pile,		1st.	8 ft.	18½*
		“		2d.	9 ft. 6½ in.	9½ “
		“		3d.	10 ft. 4 in.	9½ “

* Mud.

The above experiments, with loads on a loose pile, tended to show that the material on which we have to build could safely be loaded with some 5,000 pounds per square foot. Beyond this amount of load the case begins to appear doubtful, and on arriving at the load of 16,700 pounds per square foot a continuous yielding occurred for several days, amounting to some nine inches in all. The weight of the wall itself, allowing for the effect of the water at low water, is but 2,500 pounds per square foot. The additional load imposed upon it by the ballast and filling, under the most favorable arrangement of this load proposed, will about reach 5,000 pounds in all for the front half of the foundation, and might considerably exceed that limit, if care be not taken in securing a porous ballast, and disposing it properly in layers.

The next step was to determine what amount of friction this clay would afford as a resistance to the sliding outward of the wall on its base, where it has no foothold, standing on a level with the harbor floor.

For this purpose a rough block of granite was dragged over a level bed of the clay, immersed in water, while the amount of force needed to produce sliding was measured with a spring-balance. A mean of some forty-five trials gave for the co-efficient of friction at starting 0.328, and after starting 0.224 while in motion. In practice this can be largely increased by depositing broken stone on the bottom.

This wall, if overloaded, might fail either by sliding forward on its base, or by rolling forward around some part of its base, by the slipping out of the clay from under its front. It therefore becomes important to ascertain, as nearly as may be, the greatest pressure likely to be imposed upon it from all causes, together with the centre of such pressure and its direction. The maximum pressure is supposed to be exerted by a prism of the filling limited on one side by the back of the wall, and on the other by a sloping plane intersecting the back at its base, with an inclination of one-half the angle of repose, counting from the vertical. If such a prism were supposed to slide downward on this last-named side, the centre of pressure against the wall is necessarily at one-third the height of the wall. Its value in a horizontal direction, then, regardless of friction, is, for a unit of length, expressed by the formula—

$$P = \frac{w h^2}{2} \times \text{tang. } \frac{1}{2} \varphi.$$

w being the weight of a cubic unit of the filling;

h being the height of the wall, with vertical back;

φ being the angle of repose of the material, counting from the vertical.

The effect of friction, however, need not be ignored. Jacob, in his treatise on the "Practical Designing of Retaining Walls," gives this friction against the back filling as equivalent to $\text{tang. } \frac{1}{2} \varphi$ as a factor, so that the above expression becomes—

$$P = \frac{w h^2}{2} \times \text{tang. } ^2 \frac{1}{2} \varphi.$$

This is a simple expression, but the effect of friction is by no means so easily determined, and constitutes an important element in all such questions. The natural resultant of gravity and the friction between the parts of a mass of earth, is the "angle of repose" of the material. But this angle varies largely under different circumstances in the same material. Loose gravel, when exposed to the rains, stands at an angle of about one and a half base to one of height. The same material, when exposed to the disturbing action of waves, assumes a flatter angle, requiring a width of base about twice and one-half its height. But we have to deal with neither of these cases. The ballast behind this wall is to be deposited in layers in the water, where it is subjected to the action of waves at every tide during the process of filling, till it becomes as compact as the natural deposits or beds of drift composing our gravel hills. This same sort of material is often seen in cutting into such a natural deposit standing for weeks and even months at a very high angle, even when perfectly free from the cementing influence of clay. The force tending to hold it in such a position is evidently friction between its parts, brought to a high state of efficiency, or in other words largely increased, by the close packing of these parts. Its final instability in such positions is due to new influences and forces, coming from the movement of other bodies around it, and a very slight support suffices to retain its position. As soon as the friction is overcome, the mass assumes the usual angle of about $33^\circ 20'$ with the horizon, the particles being perfectly loose, and taking new hold of one another. A newly-filled bank of earth will therefore exert a very much greater pressure against a retaining wall than the same mass after giving it time to become so packed as to develop the full amount of this friction. Hence retaining walls often fail, to a certain extent, directly after the back filling is applied; but if standing through this period, they rarely fail, unless from some new cause, which may be controlled and averted. The most common of such new causes is lack of drainage and an excess of water held in the upper layers of the filling by the impervious nature of the layers lying below. Water, in such a case, not only adds to the pressure by its own weight, but tends to destroy friction by its own motion.

It therefore becomes of vital importance,—

First. To secure a *perfectly porous* material for that part of the back filling coming near the wall, so the tides may rise and fall within its mass in sympathy with the open water outside ; and

Second. To deposit the filling in layers, sloping *from the wall*, and to allow a sufficient time to elapse before fully loading the wall to enable the lower layers of the filling to become well compacted under the influence of the waves and tides.

If proper care be taken to secure these points, there will not, in my opinion, be sufficient lateral pressure to either slide the wall on its base, or to roll it forward by the yielding of the clay under its front. Without such care, however, a very much heavier wall would be likely to fail in either one or both of these ways.

Respectfully submitted by

Your obedient servant,

EDW. S. PHILBRICK.

Boston, December, 1875.

[B.]

ARTICLES OF AGREEMENT

Made this thirteenth day of June, A. D. 1875, by and between George Clapp and Frederick K. Ballou, both of Boston and the county of Suffolk, and said Commonwealth, partniers under the firm and style of Clapp and Ballou, being parties of the first part, and the Commonwealth of Massachusetts, acting by its Board of Harbor Commissioners, party of the second part.

WITNESS :

The said parties of the first part hereby covenant and agree with the said party of the second part, to build a light sea-wall, to inclose a dock, upon a parcel of land and flats belonging to the party of the second part, situated in Boston Harbor, as follows :—

Beginning at a point in the line of the heavy sea-wall now being constructed, distant two hundred and twenty-two and one-half feet ($222\frac{1}{2}$) westerly from the boundary line of flats sold to the Boston & Albany Railroad Corporation; the central axis of said dock shall lie parallel with said boundary line. The side walls of the dock shall be connected to the heavy sea-wall on each side, at which point the dock shall have an opening of one hundred and forty-five feet between the timber platforms and an opening of two hundred and twenty-five feet between its side walls and their top line, the said timber platforms being intended to be forty feet wide at this point, on each side. The length of the dock shall be eight hundred and fifty feet from the face of the heavy sea-wall back to the cross-wall at the head of the dock, measuring on the axis of the dock at the level of the top of the walls. The side walls shall be built upon such curved lines as may be given by the engineers hereinafter named, and shall be symmetrically placed on each side the axis of the dock. The width of the dock at its inner end shall be one hundred and twenty-five feet (125) between the timber platforms, and one hundred and sixty-five (165') between its walls, the said platforms being intended here to be twenty feet wide on each side. The cross-walls shall be at right angles with the axis and bonded into the side walls.

Said walls shall be built in accordance with the plan of light sea-wall bound into the eighth annual report of the Board of Harbor Commissioners, except that the ballast behind the same may be of gravel, placed at such slope as it will assume, and extending to the top. It shall be built in such location as shall be marked out by the

engineer of the Board of Harbor Commissioners previous to the commencement of operations by the parties of the first part; and the parties of the first part shall preserve the location by driving piles to hold the lines permanently.

The trench shall be dredged for the wall under the direction of said engineer, to a depth of two feet below low water, spring tides. The foundation piles to support the wall shall occupy a space ten feet wide, having five piles in parallel rows, said rows to be two and one-half feet distant from centre to centre of each row.

All piles shall be driven into the hard clay stratum to the satisfaction of the engineer of the Harbor Commissioners. The piles to be in diameter not less than ten inches at low-water mark, spring tides, at which point they are to be sawed off level with each other.

On the top of the piles are to be spiked two layers of spruce plank, twelve inches wide and three inches thick, lying at right angles with each other. The space between the heads of the piles, for two feet in depth, to be filled and well rammed with stone-chip ballast or oyster-shells.

The wall, from low water of spring tides to the top of the coping-stones or grade sixteen, shall be eighteen feet in height, with a true batter front and rear. The wall shall be nine feet wide at the bottom, and five feet wide at the top, including an offset of one foot for a resting-place for cap to support the ends of platform joists; to be constructed of good quality granite rubble-wall stones, from one foot to three feet thick, with sufficient headers to secure stability of the wall, well bonded and pinned throughout.

The rear of the wall shall be ballasted with oyster-shells, broken stone or gravel, from the back of the wall to a line commencing at a point two feet in rear of the back of the top of the wall, and extending in a natural slope to the base of the wall.

At the end of the wall a flank shall be built, to connect this wall with the adjoining heavy sea-wall, according to the direction of the engineer of the Board of Harbor Commissioners.

Near the junction of the dock walls and the heavy sea-wall, rip-rap of broken stone of mixed sizes shall be applied in such place and in such manner as directed by the engineer in charge of the work, on the outer face of the foundation, under the intended platform.

This wall to be commenced at once, and the work to be prosecuted without delay to its completion, and completed on or before the first day of July, in the year eighteen hundred and seventy-six.

All material obtained from the dredging required by this agreement may be used as filling, except above grade thirteen.

And said parties of the first part further covenant and agree with said party of the second part to give the Board of Harbor Commissioners and its agents every facility that may be required by said Board for the inspection of materials to be used and of the work done by said parties under this agreement and while such work is in progress ; and also agree, if at any time during the progress of the work, any work shall be done, or any material used which shall be considered by the engineer of said Board unfit and inferior according to the true intent of this agreement, that, upon receiving notice thereof, they will forthwith remove such objectionable work or material and substitute other in its place which shall be satisfactory to such engineer.

The said party of the second part hereby covenants and agrees with said parties of the first part to pay said parties for building said sea-walls in the manner and upon the terms and conditions herein set forth and agreed, as follows: At the rate of thirty-nine dollars for every lineal foot of finished wall, and at the rate of one dollar and twenty-five cents per ton of certified weight of rip-rap in front of foundation.

Payments will be made every month for the work performed under this contract to the satisfaction of the engineer of the Board at the rate of ninety per cent. of the contract price of the work done during the month as reported and certified to by the said engineer, and upon the approval of the bills by the Board of Harbor Commissioners and the governor and council. Such payments may be made to and receipted for by some party authorized to receipt for the same by an instrument in writing duly executed by said parties of the first part.

It is further agreed by and between the parties hereto, that whenever the appropriations of the legislature now or hereafter made for the work herein contracted for shall become exhausted before the work is completed, then no more work shall be done, and neither of said parties shall be under any obligation to proceed further under this agreement ; but so long as there shall be appropriations of the legislature from which the work as it is done can be paid for from month to month as herein provided, this agreement shall be in full force and virtue.

It is further agreed, by and between said parties hereto, that any person shall be deemed the engineer of the Board of Harbor Commissioners, within the meaning of this agreement, whom said Board shall, at any time or from time to time, designate for the performance of any service it may desire in relation to the work to be done under this agreement.

It is further agreed, by and between said parties hereto, that the Harbor Commissioners, subject to the approval of the governor and

council, shall have the right to make changes in the plan of doing said work, should occasion arise, and make such additions to and reductions from the contract price as shall be just to both parties.

It is further agreed, by and between said parties hereto, that should the parties of the first part refuse or neglect to execute, according to this agreement, the work herein contracted for, or fail to prosecute with the requisite vigor to insure its completion within the time agreed upon, or in any other respect violate this agreement, the Board of Harbor Commissioners shall have the power to annul this agreement and to contract anew with other parties.

It is further agreed, by and between said parties hereto, that in case any difference shall arise under this agreement between the parties of the first part and the party of the second part, acting by the Board of Harbor Commissioners, that the said parties of the first part and said Board are unable to settle and adjust, the same shall be finally determined upon hearing by the governor and council.

In testimony whereof, the said George Clapp and Frederick K. Ballou have hereunto set their hands and seals, and the said Commonwealth has caused its corporate seal to be hereto affixed, and these presents to be signed and delivered in its name and behalf by Josiah Quincy, Albert Mason, Frederic W. Lincoln, Joshua N. Marshall, and William T. Grammer, its Harbor Commissioners, and the same to be approved by its governor and executive council the day and year first above written.

GEORGE CLAPP. [SEAL.]
FREDERICK K. BALLOU. [SEAL.]

COMMONWEALTH OF MASSACHUSETTS,

By JOSIAH QUINCY.
FREDERIC W. LINCOLN.
JOSHUA N. MARSHALL.
WILLIAM T. GRAMMER.
ALBERT MASON.

Signed, sealed, and delivered in the presence of [the word "*thirtieth*" first written over an erasure, the words "*eleven*" and "*ten*," and nine other words first scored, and the words "*hereinafter named*," "*ten*," and "*nine*" first interlined, also the words "*eighteen inches to two*" first scored, and "*one foot to three*" first interlined]

HENRY L. WHITING. [SEAL.]

[C.]

B O N D .

KNOW ALL MEN BY THESE PRESENTS :

That George Clapp and Frederick K. Ballou, both of Boston, in the county of Suffolk and Commonwealth of Massachusetts, partners under the firm and style of Clapp and Ballou as principals, and George W. Townsend of said Boston and Joshua Phillips of Weymouth, in the county of Norfolk, as sureties, are holden and stand firmly bound and obliged unto the Commonwealth of Massachusetts, in the full and just sum of twenty-five thousand dollars, to be paid unto the said Commonwealth of Massachusetts ; to which payment well and truly to be made we bind ourselves, heirs, executors, and administrators firmly by these presents.

Sealed with our seals. Dated the thirtieth day of June, in the year of our Lord one thousand eight hundred and seventy-five.

The condition of this obligation is such, that if the above bounden Clapp and Ballou shall faithfully, well and truly perform their obligations under the agreement of even date with these presents, made by and between them and the said Commonwealth, for the construction of a dock in connection with work in progress upon the Commonwealth flats at South Boston, and shall do or cause to be done according to the requirements of said agreement, in the manner and upon the terms and conditions therein set forth, all the work in said agreement contracted for, then this obligation shall be void ; otherwise remain in full force and virtue.

GEORGE CLAPP.	[SEAL.]
FREDERICK K. BALLOU.	[SEAL.]
GEO. W. TOWNSEND.	[SEAL.]
JOSHUA PHILLIPS.	[SEAL.]

Signed, sealed, and delivered, four printed words first erased, in presence of

A. D. McCLELLAN.

[D.]

To His Excellency WILLIAM GASTON, *Governor, and the Honorable Council.*

By chapter thirty-four of the Resolves of the year 1874, the Board of Harbor Commissioners were authorized to compromise and settle, in behalf of the Commonwealth, any demands that seem to the Board just, of any persons or corporations for injuries resulting to meadows, flats and beaches in Truro and Provincetown, from the construction by the Commonwealth of a dike across the outlet of East Harbor, or to purchase in behalf of the Commonwealth the fee of said meadows, flats and beaches, or any part of them; to receive on behalf of the Commonwealth conveyances or releases of the same or agreements concerning the same; provided, however, that such settlements, purchases, conveyances, releases or agreements, shall be subject to the approval of the governor and council. The Resolve also authorizes agreements for the future use and occupation of said meadows, flats and beaches, and appropriates for the purposes named the sum of ten thousand dollars.

The Harbor Commissioners, under chapter twenty of the Resolves of the year 1872, had already visited the locality and given a hearing to the meadow owners, a report of which, with an opinion from James B. Francis, engineer, and an estimate of damage made at that time by a committee of the owners, will be found in the eighth annual report of this Board. The negotiations which were then suspended, because the means at the disposal of the Board were insufficient to meet the view of the meadow owners, have been resumed under the later legislation, and after many conferences and much examination of the subject, a plan of settlement and purchase has been reached, subject to the approval required by the Resolve.

The plan reached, the Board believe to be wise for the Commonwealth to adopt, and to be as nearly just to the meadow owners as any settlement practicable. There is of necessity great difficulty in apportioning the damage occasioned by the dike; some of the meadows injured were of greater value than others, and some of less value received more injury than others. The plan of apportionment which the Board have adopted is that which the meadow owners have agreed on with each other, and has the merit that it will be satisfactory to them, as well as proximately just. The meadow owners claim and seem to establish that time has proved

the injury to their property resulting from the dike to be greater than they had estimated. It is not easy to determine what the damage to the property of the meadow owners really is. The meadows affected were almost the sole reliance of the farmers of the locality for hay, and an indirect injury results, from their being rendered unproductive, to the entire community, aside from the direct loss of property in the meadows. The meadow owners do not easily separate the indirect loss which they share with the community from that which is peculiar to them as property-holders. This Board has thought it important that the Commonwealth should acquire in the settlement full control of the meadows for all possible needs of the dike or harbor in the future, leaving to the present owners such improvement of the same as they may make, consistent with that purpose. To this end the settlement recommended embraces taking the fee of the meadows by deed from the several proprietors, with a reservation "to the grantor and his heirs and assigns the right to cut grass from the granted premises, and to cultivate, use and improve the same fully and freely in any manner consistent with the use which the said Commonwealth or the United States shall make of the same, for the protection and improvement of Provincetown harbor, whether by maintaining, extending or altering any existing work, or by the construction of any new work which said Commonwealth or its authorized agents, or the United States shall deem expedient for the protection or improvement of said harbor."

The form of deed prepared, containing this reservation, and, in addition to a grant of the fee, covering a full release of claim for damages resulting from the dike, is submitted with this Report. The form is satisfactory to the legal adviser of the meadow owners, and is believed by the Board to secure to the Commonwealth all that is essential to its purpose. There are, as near as can be ascertained, and by the measurement adopted for the settlement, 400 acres of meadow affected by the dike. A payment of \$25 per acre amounts to the sum of \$10,000, which is the entire appropriation provided. The meadow owners claim that this sum is insufficient to compensate them for the injury they have sustained, and no less sum will be accepted by them in settlement. This Board is of opinion that if the fee of the meadows can be obtained and final settlement made by deed, as agreed, at an average cost, including expense of examining titles and effecting transfers, of twenty-five dollars per acre, it is for the interest of the Commonwealth to make the settlement. The Board in accordance with this view have caused an examination of the titles in the meadows in question, to be made by Smith K. Hopkins, Esq., register of deeds for Barnstable County, who is also

a lawyer and familiar with the locality, and have arranged for the same gentleman to make the deeds of the several owners and attend to the execution of the same in accordance with the form adopted. There are some portions of the meadows to which no record-title is found, and some to which the title is defective in the claimants. The defective titles can in some instances be made good and in some may prove incurable. The plan which has been agreed upon, subject to the approval before mentioned, is as follows, viz.: First, to pay from said appropriation the expenses aforesaid; second, to pay one-fifth of the residue to "The Proprietors of Eastern Harbor Meadows," the corporation owning 86 acres of said meadows, upon its giving deed as before indicated; third, the remaining four-fifths of said residue to be apportioned upon the 314 acres held by individual proprietors, giving for the meadows, upon what is known as Cedar Island, four-fifths per acre what is allowed per acre for the other meadows of individual proprietors; fourth, payment to be made to each claimant upon the approval of his title by the examiner before named, and upon delivery of the deed as before provided. This will leave a small portion of the appropriation unexpended, in amount, according to the extent to which the titles of claimants are found defective. If any who fail to establish their title before the appropriation shall have lapsed, shall be able to give the Commonwealth good title hereafter, the settlement now made will form an equitable basis for adjustment with them in such form as the legislature may determine; and those whose title is approved, but who fail to give the deed required while the appropriation remains in force, if there should be any such, will also wait for further action of the legislature.

To show more clearly the relative situation of the meadows and dike, a tracing of the locality is appended to this Report.

The Board respectfully report their action, and the foregoing plan of settlement and purchase, for the consideration of the governor and council, and await the approval required by said Resolve, before proceeding further in the premises.

JOSIAH QUINCY.
F. W. LINCOLN.
J. N. MARSHALL.
W. T. GRAMMER.
ALBERT MASON.

Boston, December 1, 1875.

COUNCIL CHAMBER, December 13, 1875.

Approved in Council.

OLIVER WARNER, *Secretary*.

[E.]

MEMORIAL TO CONGRESS IN BEHALF OF BOSTON
HARBOR.

HARBOR COMMISSIONERS' OFFICE, }
No. 8 PEMBERTON SQUARE, BOSTON. }

*To the Honorable Senate and House of Representatives of the United States, in
Congress assembled.*

The undersigned, Harbor Commissioners of the Commonwealth of Massachusetts, acting under the authority and on behalf of said Commonwealth, respectfully present the following memorial.

In the main channel of the upper harbor of Boston a shoal called "Man-of-War" or "Junction" Shoal has existed from time immemorial, near the confluence of the Charles and Mystic rivers.

This shoal has always been an obstacle to the manœuvring of the heavy ships of the navy in their passage to and from the United States Navy Yard, which is above it, and the difficulties arising from its existence are becoming more and more serious in their effect upon the commerce of the port, from the fact that the larger and deeper class of vessels of modern times require a greater depth of water than can be carried over this shoal.

The Commonwealth of Massachusetts has undertaken, with its harbor fund, to remove shoals from the water-front of the city of Boston, a work of magnitude which will consume many years.

In view of the fact that the Man-of-War Shoal is a "middle ground" within the channel leading to the United States Navy Yard, the Board respectfully suggest that its removal is a proper case for the action of the general government in its policy and plans for the improvement of navigation.

The most shallow part of Man-of-War Shoal has now about fifteen and one-quarter feet of water over it at mean low tide. The extent of the shoal, above the plan of mean low water, covers about four hundred and forty-one thousand three hundred and fifty square feet, equal to about ten and one-eighth acres. The amount of material to be removed in order to give a depth of twenty-three feet at mean low water, where the shoal now is, according to the results of a

recent survey made by direction of the Board, is about forty-eight thousand two hundred and twenty-two cubic yards.

For the reasons given above, the undersigned respectfully commend the subject of the removal of Man-of-War Shoal to the favorable consideration of Congress, and earnestly solicit an appropriation for it.

JOSIAH QUINCY.

F. W. LINCOLN.

J. N. MARSHALL.

WM. T. GRAMMER.

ALBERT MASON.

[F.]

COMMUNICATION FROM THE HARBOR COMMISSIONERS.

To the Joint Special Committee upon the Report of the Committee appointed under Chapter 88 of the Resolves of 1874, in relation to use of the Commonwealth Flats at South Boston.

The Harbor Commissioners respectfully submit the following suggestions upon the questions before the committee :—

The State, as sovereign, is the owner of the flats at South Boston, because of their relation to tide-water. It has undertaken to reclaim them in its care of tide-water. The enterprise was conceived and has thus far been executed as a harbor improvement; the value of the land to be reclaimed was only incidental to the main purpose, though it was hoped that value would be large and would secure the State from loss in its undertaking. It is already clear that the value of the land when reclaimed was not overestimated. The committee, whose report is before you, have not, probably, exaggerated its importance as furnishing facilities for the connection of the two great interests of water and land transportation. This board concurs in the opinion that the best terminal facilities for railroads possible in Boston can be provided upon the South Boston flats, and that it is in the nature of things that railroads will seek that locality for connection with deep water. The extended water-front and improved channel and water area would promise little satisfaction if they were not to be used. It is therefore encouraging to observe a desire for access to this territory, which indicates that the provision being made there is not greatly in advance of the demands and possibilities of business. The stronger the assurance that existing or contemplated railroads will require and use the reclaimed territory, the greater the inducement for the Commonwealth to proceed with the work it has undertaken; but it would be unfortunate if, by giving too much thought to pecuniary results, the primary purpose to preserve and improve the harbor should be in any degree obscured. Whatever is thought wise to secure most from the sale of the land, supervision of the filling and of the construction of retaining walls, docks and wharves,

should continue, where the interests of the harbor shall be the first care.

The general features of the plan for utilizing the flats, which is before you, are valuable. Some of the details are open to objections, which, fully considered, would probably have induced the committee to reject them, and some can only be determined by those who shall occupy the territory; but as no one probably expects or desires legislation to regulate the details of the plan, it is not necessary to discuss them minutely; it is sufficient to say they must inevitably be modified as the work progresses, in the light of continued study, and as further advances are made in all the appliances of commercial business.

There have been no sales of small parcels of the land, and no application to purchase such parcels. This board would not think the sale of small lots advisable at the present stage of the improvement. The reservation of the portion indicated upon the committee's plan for railroad and commercial purposes might not be unwise as a present policy, as when it should become apparent that so much would not be required, such reservation can be readily modified. The objection that such reservation, by narrowing competition, would depress the price of the land is not without force, but is in part, at least, offset by the consideration that assurance of opportunity for other roads to go there adds to the value for terminal business, and consequently to the inducement for each road to purchase.

The close interdependence of the interests of water and land transportation make it desirable that the negotiations and arrangements to accommodate each to the other should be as direct as practicable, and it would not seem that the intervention of a third party would facilitate such arrangements. This board does not anticipate that the difficulties of carrying out any policy which may be adopted for the sale of the lands will be such that its members would desire to be relieved from that portion of their work; but, on the other hand, if it is thought that the sale of the land and the negotiations with railroad companies that desire to occupy them, is a work of sufficient importance to justify a separate commission, or that the people would be better satisfied to have it performed by persons of different training and experience, selected for their fitness for that special duty, they would coöperate with such new commission, not apprehending any conflict of duties.

The plan to approach the territory by a tunnel under the high land at South Boston has advantages, and much of the earth excavated in constructing the tunnel could be utilized in filling the flats, but the feasibility and economy of this feature must be

determined by the railroad companies desiring to reach the reclaimed land, and the best point for its location would be more appropriately determined by the railroad commissioners.

The commercial advantage of South Bay and Fort Point Channel, extending far into the city to localities where much of its heavy water-borne freight is consumed, is very great, and has been fully discussed in the sixth annual report of this board. (House Doc., No. 56, 1872.) When the inconvenience and annoyance to other interests, from their continuance, shall outweigh this great advantage, the difficulties and cost of closing this bay and channel will be much less than they now are.

The State holds its control of tide-water, and the land it reclaims therefrom, in trust for the whole people, and all enterprises to bring these sources of wealth into greater use should be encouraged upon a wise and liberal business policy; but the State is perpetual, and it is not essential that any particular generation should derive the full benefit of the plan adopted. The policy of the Commonwealth should be that which is wisest in the end. There should not be premature forcing of enterprises which sound business foresight will not yet sustain upon established principles. Fifty acres of the flats have already been sold at a low rate to induce a strong railroad company to bring its business there, while a sale at a much higher rate to a company, strong in its promise of great capacities, proved only a hindrance to the development of the property. No early sale for railroad purposes could be made, except at low rates, and if high rates could be obtained the gain might only be apparent, as the whole people must pay, in transportation tax, the added cost of terminal facilities.

The land which the Boston and Northwestern Railroad Company require for their own use can, with propriety, be furnished upon the principles recommended in the report before you. The reclaimed lands are as fully the property of the State as the money in its treasury, and a gift of them to a railroad company, for such company by selling them to obtain means to build its railroad, is open to the same objection which the committee urge against aiding railroads from the treasury. It is open to another serious objection, that it would conflict with the spirit, if not with the letter of the pledge, which was made of the proceeds of the flats by section five of chapter 326 of the Acts of 1868.

JOSIAH QUINCY.
F. W. LINCOLN.
W. T. GRAMMER.
ALBERT MASON.



ELEVENTH ANNUAL REPORT

OF THE

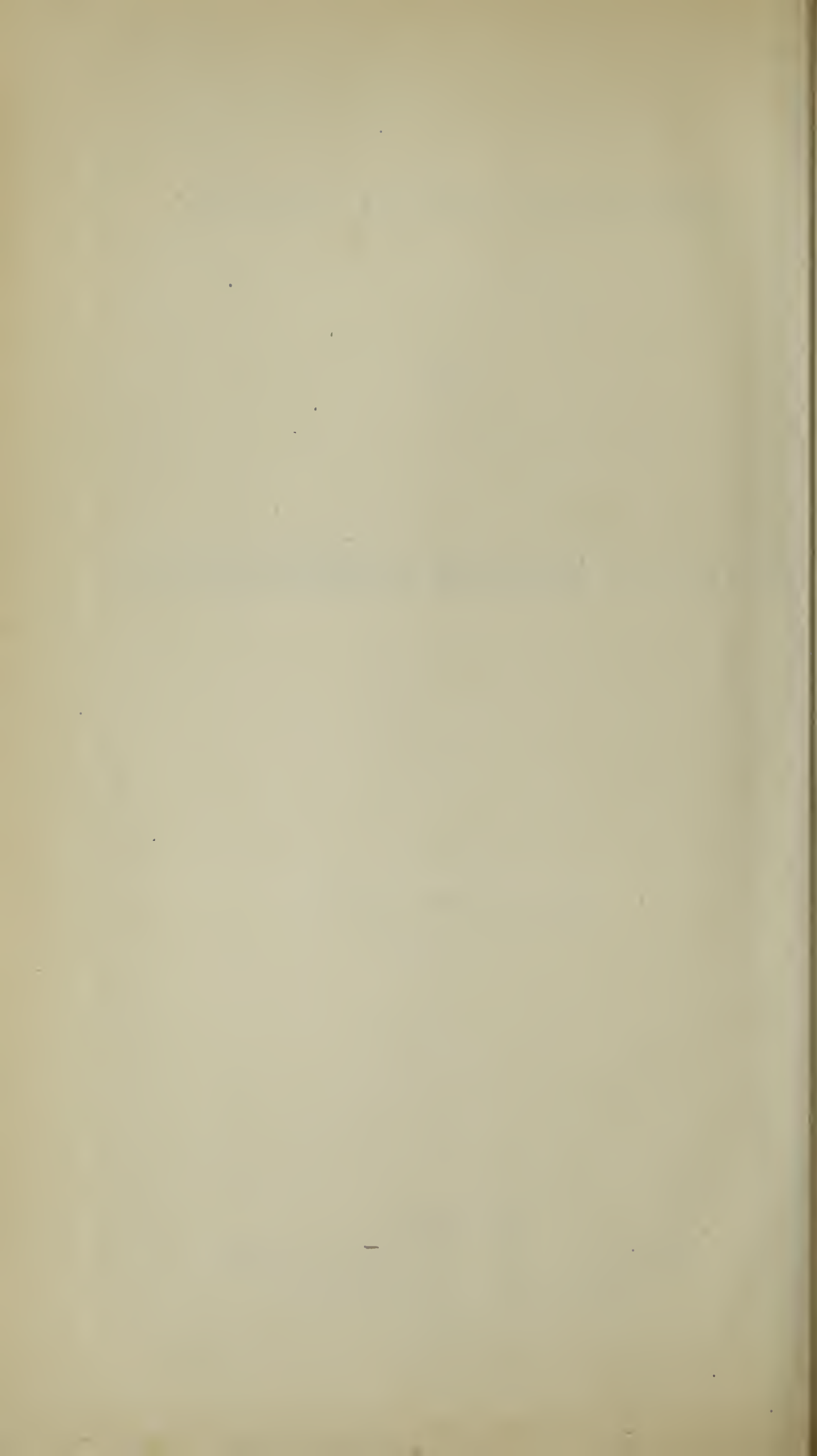
BOARD OF HARBOR COMMISSIONERS.

JANUARY, 1877.

BOSTON:

ALBERT J. WRIGHT, STATE PRINTER,
79 MILK STREET (CORNER OF FEDERAL).

1877.



REPORT.

HARBOR COMMISSIONERS' OFFICE, No. 8 PEMBERTON SQUARE, }
BOSTON, January, 1877. }

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor Commissioners respectfully submit their Eleventh Annual Report:—

SOUTH BOSTON FLATS.

The reclamation of South Boston Flats, by the use of material for filling taken from the banks and bed of the main channel, has made fair progress during the past year. The twenty-five acre piece which the Commonwealth has undertaken to reclaim, has been walled in, substantially, as far as the first dock inclusive, and requires only about 64,000 cubic yards more (which the dredging of the dock will supply) to raise it to grade *thirteen*, above which the filling is to be of gravel.

The engineer seems to have foreseen so perfectly the degree to which the rubble underlying the heavy wall would yield to the pressure from above, that now, when time enough has elapsed, in his opinion, for the entire settlement to have taken place, the coping of the wall is found to be upon its predestined grade,—sixteen feet above mean low water. The sinkage has been about six inches, and so nearly uniform, that the wall may be said to have moved as a single mass.

Excepting the removal of a considerable body of shoal ground off Long Wharf, the dredging has been confined to a belt in front of the Commonwealth's property, and a connecting channel to deep water beyond. It is designed that the dock shall be accessible at low tide for vessels from sea drawing twenty-three feet of water, and this draught can now be

carried past the front of it, into the mouth of Fort Point Channel.

The brief but comprehensive report of Mr. Edward S. Philbrick, engineer in charge, will be found in the Appendix, and may be referred to for a more precise description of the present state of the works.

In the plan for reclaiming these flats, retaining-walls of two kinds were projected: one of these was to be a heavy structure, with a rubble base resting at the bed-level of the main channel; the other, a light structure resting on piles about at the general level of the flats. Wherever the light wall was to be used, its site was set back some distance from the deep-water frontage, in order that the piles should be covered from the worms and sustained by the earth. The platform referred to by the engineer was designed to cover the shallow space between the channel and the wall, and serve as a bridge or wharf from the ship to the shore, as may be seen in the sketch accompanying the Sixth Annual Report. This platform was not, of course, to be a constituent part of the retaining-wall, and it was not anticipated that its construction would precede the demand for its actual commercial use, unless some tendency to erosion or slipping of the bank should manifest itself. The engineer, as will be seen, suggests that within the dock, where berths for ships of great draught are to be provided, the bank along the front of the light wall should be prevented from slipping, either by omitting some of the dredging, or by driving a row of spruce piles. The latter course appears to the Board most advisable; because, to omit any of the projected dredging in the dock might prejudice the sale of the property. These piles, imbedded in the mud, will neither perish from decay nor worms, so that their office will be permanent; and, as a guide to the dredging party, they will be of no small value, experience having shown that the utmost vigilance of the Board, the engineer in charge, and the inspector, fails to prevent irregularity in dredging, both as regards alignment and depth.

It was obvious, at the beginning of the year, that it was impossible for the contractors to complete their work by the first day of October, as stipulated in their contract; and the Legislature appropriated only what might be required within

the year. It does not yet appear that the State will suffer from the delay of the contractor, and it is quite certain that in some respects the work is much better for less haste. Of the original estimate of the engineer, there remains unappropriated \$98,521. If to this is added the sum named by him for the piling necessary to secure the bank from slipping, \$4,000, the amount to be appropriated for the coming year, during which it is expected the work will be completed, is \$102,521.

Dumping-grounds.

During the past season, the Board called the attention of the agents for the Commonwealth Flats at South Boston, to the fact, that in the execution of the dredging by the Board, in the application of the income from the compensation fund to harbor improvement, as well as in the dredging by private parties and corporations, there would be large amounts of material to be disposed of, valuable for filling.

The agents responded cordially, and, in conference, laid off a portion of the South Boston Flats, beyond and adjacent to the territory sold to the Boston & Albany Railroad Company, and, in conjunction with the said railroad company, built suitable bulkheads for securing the material from waste.

At the time that the engineers of the United States commenced their excavations at the Upper Middle Bar, the material removed had no market value, principally because the large scows used by the contractors drew too much water to be floated upon flats then in process of reclamation. The Board suggested about that time, that a location could be given for depositing the material upon the South Boston Flats, provided bulkheads should first be built to prevent its return to the main channel. It appeared, however, that the provisions of the appropriation bill, under which the dredging was being done, did not admit of any expenditure on constructions like that suggested. The Board then gave the ranges of an unfrequented portion of the Lower Harbor, near Hangman's Island (belonging to the Commonwealth), where the material could be dumped without injury to valuable channels. All other persons, whether contractors for the Commonwealth or for private parties, who could not usefully

dispose of material of this kind, were directed to carry it to the same place. The Board was not without misgivings that the remoteness of the ground assigned might induce the bargemen, under cover of night, or amid the hardships of stormy weather, to unload prematurely; and therefore informally represented to the United States engineer, that the public interest would be best secured if the inspector, who made the count upon which the contractor was paid, could be located at Hangman's Island, and thus secure the delivery of material at the proper place. This arrangement could not be made, and the Board resorted to what seemed to be the next best course, which was to request the harbor-master, Capt. Francis C. Cates, to keep a strict watch, and report to the Board delinquencies of the kind referred to. This proved to be a very timely step; the vigilance of the harbor-master led to the discovery of several cases of scow-loads dumped in the channel-way, of which the Board made representation to the United States engineer, who ordered their removal, or the dredging of an equal amount from the shallowest part of the channel.

SHOALS IN BOSTON UPPER HARBOR.

In pursuance of the authority granted to the Board, the work of dredging the shoals in Boston Upper Harbor has been continued, and new work has been begun during the last season. Peculiar difficulties have arisen in dredging along the immediate front of the business portions of the city, which have caused unlooked-for delay and embarrassment in the execution of the work.

The new work commenced is that referred to in the last report of the Board, off the water-face of East Boston, and consists in the removal of the shoal ground in front of the south dock of the National Dock and Warehouse Corporation, and includes an area of about 68,400 square feet. Contracts have been made with the Harbor Improvement Company for the execution of this work, which has been nearly completed.

Petitions have been presented to the Board by the Cunard Steamship Company, and by the Boston & Albany Railroad Company, for the removal of shoals off their respective front-

ages in East Boston. A survey has been made of the ground in question, and an approximate estimate made of the dredging required, which amounts to about 103,000 cubic yards.

The localities referred to are shown in the Appendix, on a map, entitled "A Map of a portion of Boston Harbor." The petitions above referred to, will also be found in the Appendix.

CHARLES RIVER BASIN.

The Cambridge Improvement Company and others, acting under the license of the Board, dated April 27, 1875, have continued their improvements between West Boston and Cragie bridges, and have executed the following work:—

One hundred and twenty-three thousand four hundred and five cubic yards of material have been dredged as compensation for tide-water displaced by their structures and filling.

Five hundred linear feet of sea-wall have been built.

One hundred and seventy linear feet of foundation and ballast for sea-wall have been laid.

Seven hundred linear feet of wooden bulkheads have been built.

In addition to the above work, the city of Cambridge has built Binney Street sewer, and filled in material as ballast to it, which has been dredged from the channel of the basin above West Boston Bridge, to the amount of 7,000 cubic yards.

BOSTON LAND COMPANY.

The Boston Land Company has brought to the attention of the Board, a project for creating on the flats of the company lying on the south-easterly side of Breed's Island, occupied in connection with territory in tide-water beyond the line of the riparian title, a new and extensive water-frontage suitable for ocean steamers and vessels of the largest class. This frontage it is proposed to develop in connection with a tract of land to be raised to the proper grade from tide-water by filling, and to be improved for docks, wharves, warehouses, railroad tracks, and all the facilities for the landing and shipping of cargoes.

The construction of a ship channel, deep enough for vessels

of the greatest draught of water, extending from the main channel of the harbor near Governor's Island, is an essential part of the scheme.

This enterprise, we understand, will be brought to the attention of the Legislature during the present session.

GREEN HARBOR RIVER.

As a basis for the action of the Board, the engineers were directed, during the last summer, to make a survey of Green Harbor River, in Marshfield, including the bar outside of the headlands of the harbor, or anchorage basin, and the part of the river above the basin and below the dike erected in 1872.

This survey has been accurately made. The tidal data have been obtained from observations made at Boston Light and at Green Harbor, and these results compared with those of Prof. Mitchell at Sandwich, taken in connection with his survey of 1860 for the Cape Cod Ship Canal, and also with the results of Col. Graham's surveys at Provincetown in 1833-35. From all these observations, the plane of mean low water for this part of Massachusetts Bay has been determined, and permanent bench-marks established at Green Harbor, to which all the levels of the recent survey refer.

The high-water outline of the beach, harbor and river, from Bluefish Rock to the dike, with some marginal topography, have been surveyed, and points identical with those of the United States Coast Survey of 1857 determined, sufficiently well to give a basis for the comparison of the high and low water lines of the two surveys. The contours of the bar, channel, and bed of the harbor basin, as far up as the lower end of the first marsh island, have been determined by numerous level stations.

At the time that the project for the dike was under consideration, no survey of the bar and mouth of the river was made. As far as could be observed, the Coast Survey map still represented the general features of the topography, and no change decidedly detrimental to navigation had occurred. No soundings were furnished upon the map just mentioned; but by inquiry of fishermen the surveyors satisfied themselves that the harbor proper had remained essentially the same; while it was manifest that a considerable increase of the beach

separating Cut River from the sea had taken place, and this seemed to threaten the entrance, as a remote possibility.

As has been said, no soundings are furnished by the topographical map of the Coast Survey (1857), and therefore the estimate that will be first given of the *total* deposit which has taken place in the interval between the two surveys is only an approximation,—but a safe one, it is believed, in the respect that it is not an exaggeration. The portions of the two maps which have been compared may be distinguished as the *basin* and the *bar*,—the former being the space between the Narrows at Washburn's Point and the first marsh is land above, about $8\frac{1}{3}$ acres as limited by the low-water lines of 1857; and the latter, the low-water space of $13\frac{3}{4}$ acres (1857) seaward of the Narrows, limited by the arc of a circle passing through the extremity of Bluefish Rock,—the said circle having a radius of 1,900 feet, with its centre at the outer end of the first wharf or stage now existing at Cut River Village.

In the basin, as above described, the total deposit amounts to about 52,000 cubic yards since the dike was projected; and on the bar, the total deposit since 1857 amounts to 106,000 cubic yards. The amount deposited in the basin, above *the plane of mean low tide and beyond the low-water lines* as they existed before the dike was projected, amounts to 23,000 cubic yards; while the amount similarly deposited upon the bar since 1857 amounts to 63,000 cubic yards.

It would be unwarrantable to attribute the whole accumulation over the spaces examined to the reduction of the tidal scour which was formerly strong enough to keep the entrance free. The very fact that there are such great volumes of sand drifting along the coast, ready at every flood-tide, or inroad of storm seas, to enter all the rivers and creeks, might lead one to expect that gradually all basins (as distinguished from channels) are to be filled up. The case of Plymouth Harbor, in this very neighborhood, is the best illustration of this. The recent Coast Survey Chart, compared with those of the seventeenth and eighteenth centuries, shows that many millions of cubic yards of sand have accumulated in the main ship channel and in the bay below Brown's Island (see a report on the Physical History of Plymouth Harbor, in Ap-

pendix). Moreover, some observations made by the Coast Survey during the past year, being compared with others of previous years, indicate that in the portion of Cape Cod Bay, adjacent to the neighborhood under examination, there is a meeting of very peculiar coast currents, bearing material for shoal-building.

The Board, after carefully considering all the possibilities of the case by the light of the recent surveys and studies of its engineers, saw no sufficient reason to change the opinion, expressed in the report of last year, "that what has occurred must be mainly attributed to the dike." An order was therefore issued directing the removal of the accumulation, or so much of it as may be necessary to secure a channel for the passage of boats and small vessels.

The channel referred to, in the order which follows, was located upon the most recent survey in such a manner as to require the least excavation,—as far as such an economical consideration was consistent with the main purpose of the work. Within the pathway of this channel, three shoal places occur where the surface of the bottom is at, and above, the plane of mean low water. The first, or larger shoal, is within the harbor basin and above Washburn's Point, and makes a channel bar of about 600 feet in length, ranging from 0, on the low-water plane, to 1.6 feet above it. The second shoal is opposite Washburn's Point, and forms a channel bar of about 200 feet in length, ranging from 0 to 0 8 feet above. The third shoal is about half-way between Washburn's Point and the outer harbor line of the main shoal, and forms a channel bar of about 75 feet in length, at about 0, or low water plane. The area contained within the lines of the prescribed channel referred to is about eight acres, and while the maximum shoaling is 1.6 feet, the average over the whole channel will amount to about 10 inches.

The statute provides that if the proprietors fail to remove the obstructions as required within six months after due notice, the Harbor Commissioners shall cause the same to be removed at the expense of the said proprietors.

There is no fund from which this Board could pay for such a removal until reimbursement could be obtained from the proprietors, and it is not probable that any contracts could be

made with payments contingent upon recovery from the proprietors; and thus for all practical purposes the power of the Board is exhausted in giving the notice unless further provision is made. What effect a failure of the proprietors to comply with the notice will have upon the legality of the structure can only be tested in the courts.

COMMONWEALTH OF MASSACHUSETTS.

HARBOR COMMISSIONERS' OFFICE, 8 PEMBERTON SQUARE, }
BOSTON, September 13, 1876. }

To the Proprietors of Green Harbor Marsh, mentioned in Section four of Chapter three hundred and three of the Acts of the year eighteen hundred and seventy-one.

Whereas, The proprietors of Green Harbor Marsh, in the town of Marshfield, were by the provisions of chapter 303 of the Acts of the year 1871, authorized to erect a dam and dikes across Green Harbor River at or near and not above Turkey Point, so called, with one or more sluice-ways and gates for the purpose of draining Green Harbor Marsh and improving the same, and preventing flowage from the sea; and

Whereas, The said proprietors did, under the authority of the said Act, erect a dam and dikes across said Green Harbor River, at the place and for the purposes contemplated and provided for in said Act; and

Whereas, By the fourth section of the said Act, it was provided, that should shoaling take place above the level of mean low water in the channel of Green Harbor River, and its approaches below the dam and dikes in consequence of the construction of said dam and dikes, said shoaling shall be removed by the proprietors of Green Harbor Marsh under the direction and to the acceptance of the Board of Harbor Commissioners; and

Whereas, The undersigned, the Harbor Commissioners mentioned in and intended by said Act, upon a full hearing and an inspection and examination of said dam and dikes and said river, do find and determine, that shoaling has taken place above the level of mean low water in the channel of said Green Harbor River and its approaches, below the dam and dikes erected as aforesaid in consequence of the construction of said dam and dikes;

Now, THEREFORE, you are hereby notified and required to remove said shoaling and obstructions from the channel of Green Harbor River and its approaches, and in doing so you will be governed by the following directions, to wit:—

The obstructions of sands above the level of mean low water lying within the following prescribed lines, shall be removed :

The easterly and northerly line shall begin at a point in the line of mean low water, on the southerly side of said river, about midway between the easterly and westerly high-water shores thereof, and distant about 300 feet southerly from the southerly point of the marsh island next above it, and shall follow the general course of the present low-water channel south-easterly to the foot of the strand, or bank left bare at low water, on the easterly side of said river, distant 80 feet from a salient point in the high-water line thereof; thence following the general curve of the shore along the foot of the strand, in a southerly, south-westerly and south-easterly direction, around the point of beach which forms the south-easterly point, or headland of Green Harbor, at distances varying from 50 to 80 feet from the high-water line of said point of beach; thence, still following the general trend of the foot of the strand, at distances varying from 160, 150, 230 and 330 feet (at Bluefish Rock) from the high-water line to the low-water line of the main shore. The westerly and southerly line shall run from the point of beginning in the low-water line of said Green Harbor, parallel to the above described easterly and northerly line and distant from it 100 feet for a distance of 1,550 feet; thence the line shall run straight in a southerly and little easterly direction, for a distance of about 700 feet to a point in the low-water line of the main shore, distant 500 feet south-westerly from the end of the first-described line.


The space enclosed within the above-described lines is shown in red color upon a plan of said harbor on file in the office of this Board, entitled "A Map of Green Harbor, Mass., showing the channel and its approaches at mean low water."

Or an excavation in the channel of said river and its approaches to the level of mean low water having a width of not less than 100 feet from the harbor basin to past the headlands of the same, having a width of not less than 500 feet at the low-water line of the main shore, may be made, following any other course from the point of beginning, before mentioned, to the sea, satisfactory to this Board.

The level of mean low water is referred to the following described bench-marks :

Bench-mark A is situated on the top of the smaller and more northerly of two bowlders in the marsh, situated 70 feet N. N. W. from a bridge over a creek in said marsh, and is also 245 feet S. S. E. from the chimney of Mr. Thomas Keith's house, and is marked by two cuts in the rock, thus, **Λ**. The height of this bench-mark above the level of mean low water, is 10.740 feet.

Bench-mark B is situated on the top of Bluefish Rock, 74 feet N.

E. of the highest point of said rock, and is marked by three cuts in the rock, thus, . The height of this bench-mark above the level of mean low water, is 18.260 feet.

GLOUCESTER.

The rapid development of the fisheries and kindred interests at Gloucester, during the past ten years, has given to this port peculiar importance among our commercial stations.

This harbor, called by Champlain, who visited it in 1606, *Le Beau-port*, has sustained its good name. No diminution of depth has taken place at its entrance, and none within the roadstead as far up, certainly, as Rocky Neck. Opening to the south-westward without actual obstruction in the approach, "this port," as Champlain reported, "is very fine and good,—having enough water for ships, and shelter behind the islands." According to the Annual Report of the Coast Survey for 1869, the roadstead has anchorage-room for 327 miscellaneous vessels riding freely at anchor, and an extreme exposure of $28\frac{1}{2}$ miles.

The "shelter behind the islands" is, however, quite inadequate for the great fleets of fishing and merchant vessels that now resort to this harbor; and, while it must be admitted that well-found vessels may safely ride out heavy gales in portions of the roadstead, it often happens at such times that the best locations are overcrowded. General John G. Foster, in his report to the engineer-in-chief of the United States, dated January 20, 1871, "after a careful consideration of the whole subject," proposed that a breakwater should be built, connecting Dog Bar and Rock Shoal with Eastern Point. Shelter of this kind would permit vessels to moor closely without danger of mutual injury, and thus practically enlarge the capacity of the roadstead. It would also extend the frontage suitable for wharves, etc. No appropriation has ever been made for this breakwater. In fact, the only money expended by the general government in the improvement of this harbor, within the knowledge of the Board, is the sum of \$10,000, successfully used by General George Thom in blasting out rocks or lifting bowlders from the Upper Harbor and its approach.

The Inner Harbor, upon which the city is situated, has

an ample depth in its contracted channel-way, but the shores are so flat and rocky that difficulties present themselves in the construction of landings which only a very energetic and prosperous community could have overcome. The study and approval of plans for building wharves at Gloucester, were among the earliest duties of the Board, and in assisting to reconcile conflicting claims upon the flats that lay in front of riparian proprietorships, the Board has generally expressed its judgment after a careful consideration, and met a cheerful acquiescence from a class of busy men, who desired only their just proportions without recourse to legal proceedings.

During the past year, which has witnessed less activity in all other ports, as far as the offices of this Board extend, the calls for licenses to build wharves at Gloucester have exceeded in number those of any previous year, and have involved less conflict among the applicants and their neighbors than might have been expected in so crowded a place. The following information concerning the commerce and fisheries of this port is kindly supplied by Mr. F. T. Babson, United States collector:—

Tonnage of district, 1868,	. . . . .	26,100 tons.
Number of vessels, 1868, .	. . . . .	529
Tonnage of district, 1876,	. . . . .	34,580 tons.
Number of vessels, 1876,	. . . . .	522
Value of fisheries, 1869, .	. . . . .	\$3,600,000
Value of fisheries, 1875, .	. . . . .	4,600,000

Imports increased 100 per cent. in ten years.

Foreign arrivals increased 100 per cent. in ten years.

One hundred and twenty-five thousand hhds. of salt were imported last year in 45 vessels; tonnage, from 300 to 900 tons burden.

The trade with Nova Scotia and Canada remains about the same as in 1867. "A very large number of vessels, other than our own," says Mr. Babson, "make our harbor a place of refuge. Our boarding-officer estimates them at 3,000." "A large number of vessels from foreign countries touch here for orders; 5,140 have been boarded."

PROPOSED INLET AT OSTERVILLE.

A short time before the harbor committee of the Legislature of last year closed its hearings, the Board was requested to examine the project for an opening through the narrow beach that separates the South Bay of the Cotuit lagoons from Nantucket Sound.

The parties petitioning for the privilege of making this cut, proposed to do the work at their own expense, and no objection would probably have been made by the committee had there been no remonstrants. These remonstrants represented that the entrance to Cotuit Port would probably be injured by the creation of a new outlet, not only because the flow of the tide through the present entrance would thus be reduced, but also because the currents along the outside beach and bar of Cotuit would be changed.

An inspection instituted by the Board, seemed to warrant the conclusion that the cut, if successfully made and maintained, would reduce the flowage over Cotuit Bar, and tend to reduce the depth in something like the same proportion, but that no essential change in the currents along the outside coast would occur.

Without a regular gauging of the tides in the lagoons, the amount of injury to the present entrance, which the creation of another opening would cause, cannot be estimated closely.

PROVINCETOWN HARBOR.

The attention of the Board has been called, by the petition of parties for leave to extend wharf structures into the harbor from Long Point, to the expediency of modifying so much of the harbor line as defines the frontage of this part of the harbor, for the reason that as the harbor line is now, wharf structures cannot be extended to a depth of water suitable for commercial purposes.

It is the opinion of the Board that this part of the present harbor line can be so modified as to conserve the harbor, and at the same time admit of the extension of wharves into a depth of water sufficient to float, at their sides and ends, such vessels as are employed in the commerce of the port.

The Board will submit, at such time in the session as the

Legislature may assign for its consideration, plans for the change of harbor line proposed.

EAST HARBOR.

In pursuance of the conditions of chapter 34 of the Acts of 1874, settlement has been made with the marsh owners at East Harbor. The number of proprietors whose rights in these marshes have been bought out by the Commonwealth, is 58, and the total amount paid in settlement of the same, and for expenses, up to January 1, 1877, is \$9,756.46.

A list of the names of the proprietors will be found in the Appendix.

RE-SURVEY OF THE WHARF LINES OF BOSTON UPPER HARBOR.

In the experience of the Board, in dealing with questions of change and improvement in the frontage of the Upper Harbor, submitted by the Legislature and by corporations and individuals, the need for a new survey has been manifest for several years.

The last accurate survey which can be relied upon for the constantly required data necessary for the action of the Board in properly locating, and safely guiding, the important works which are proposed and being executed, is that made at the instance of the United States Advisory Council, in 1860-61, by Mr. Albert Boschke, now sixteen and seventeen years ago.

As may be understood, the wharf lines of the Upper Harbor have undergone many changes, in detail and in general outline during this period of time, so that difficulties and uncertainties have consequently arisen, in referring new works and improvements to the older landmarks.

The Board is already vested with authority to make necessary surveys, but the proposed re-survey of the harbor frontage will involve more expenditure than can be made under the limited appropriation for the general current expenses of the Board. In connection with a re-survey, and based upon the data which it will furnish, the Board recommends the revival of the several harbor lines.

The present harbor lines are established by various and independent acts of the Legislature, based upon unconnected

data, many of them dating back as far as *forty years*, and many of the original points of reference are lost by the obliteration of old landmarks. The lines should be referred to imperishable points, and to triangulation bases without the city, so that they can be reproduced with perfect accuracy.

The Board submits the following estimate for the proposed survey :—

For triangulation, based upon the data of the Coast	
Survey,	\$1,000 00
For detailed linear survey of wharf lines, etc., . . .	3,000 00
For accompanying hydrography in determining the	
depth of docks and slips, and the immediate wharf	
frontage,	1,000 00
	<hr/>
	\$5,000 00

REVENUE RECEIVED FROM TIDE-LANDS OF THE COMMONWEALTH.

In former times it had been the custom of the Legislature to grant the right to occupy tide-lands without compensation ; but it seemed to the Board that, in localities of commercial importance, the tide-lands had a value relative to the value of the adjacent upland, and that some compensation for such tide lands should be made to the Commonwealth in addition to the compensation for tide-water displaced by structures erected upon them ; and at the instance of the Board, chapter 284 of the Acts of 1874 was passed.

Since that time, and up to January 1, 1877, the revenue received by the Commonwealth through licenses granted by the Board, has amounted in total to the sum of \$25,233.41.

This money does not go to the compensation fund for the improvement of Boston Harbor, but to the sinking fund for the payment of the war debt.

COMPENSATION FUND FOR BOSTON HARBOR.

The following amount represents the Compensation Fund for Boston Harbor, up to January 1, 1877, \$124,903.90.

To cover works of improvement in the harbor desirable to be carried forward, the Board recommends the appropriation

of the income from the compensation fund for the current year.

HARBOR IMPROVEMENTS BY THE GENERAL GOVERNMENT.

In our first report, dated January, 1867, will be found a copy of the earnest petition which the Board, immediately after its organization, carried to Washington and laid before Congress, under the authority given by the Legislature, soliciting appropriations for the improvement and protection of the channels of Boston Harbor. Of the twelve items enumerated in that first petition, eight have received due attention, besides several others which were added by the Board, or suggested as incidental by the United States engineer in charge; and while it is to be hoped that the general government will not relax its hand till all be accomplished, it must be frankly and gratefully admitted that the heaviest ships that traverse the ocean may now seek any portion of our *four thousand acres of sheltered anchorage* without danger, and almost without the *fear* of danger. At some critical points, a vessel must still alter her course abruptly to avoid hidden rocks, but we have every reason to believe that the entire removal of these rocks will be provided for, the United States engineer in charge having made the practicability and advantage of these improvements so clear to the minds of all.

The principal dangers that ten years ago beset the entrances of Boston Harbor, by way of Broad Sound, and by way of the Narrows,—dangers that taxed to the utmost the skill of our pilots and prejudiced the reputation of the port, are gone.

In the Broad Sound entrance, there stood a rock rising within four feet of the surface at low water. Its name, "Barrel," indicated its supposed diminutive form, but there being no sign of its whereabouts, except a buoy often misplaced by sea and ice, it was a formidable danger to the vessels trading with eastern ports. It is a curious fact that this enemy at the gate, long feared and long tolerated, was blown to pieces and carried off by General Foster at an expense of but \$6,000.

In the approach to the Narrows, while the vessel is still in the sea-way, she has to pass several reefs and ledges, one of

which, "Kelly's Rock," lies in what would be her direct course if she did not turn aside to avoid it, and by this turn pass near other dangers. This rock, or group of rocks (as it proved to be), had a minimum depth of 16 feet. General Foster, and subsequently General Thom, attacked it, and now, although the work is incomplete, there are $19\frac{1}{2}$ feet clear, and but \$11,300 are deemed necessary to remove everything above the plane of 23 feet at low water.

In the Narrows there were two very contracted passes,—one between George's Island and Great Brewster Bar, the other between Lovell's and Gallop's islands. In the first of these lay two rocks, which were so much feared that heavy vessels, arriving at low water, preferred to wait for the tide, rather than venture to pass them when covered with less than their own draught of water. At this place the avenue for heavy vessels at low-water was scarcely 250 feet wide, and there was every reason to believe that if Brewster Bar continued to advance at the rate it had been doing, this channel would be closed within a century.

Under General Foster's direction the two rocks were blasted out, and under General Thom's direction, Brewster Spit and its underlying ledge were cut off; so that now the 23 feet low-water channel is 600 feet wide, and vessels may stand quite up to the Brewster Spit without fear.

The other contraction between Lovell's and Gallop's islands has been widened under the same officers to nearly 600 feet.

A rock in the middle of a channel, even when visible, reduces the beating-room of a vessel more than one-half, and when hidden, occupies in effect a much greater space, because of the uncertainty of its location. Much in the same way a hidden shoal, or extending flat, takes exaggerated dimensions in the fears of the navigator, and cramps his manœuvres unduly. The result of these improvements is, that the Main Ship Channel is, *in effect*, five times as wide as it was ten years ago.

In the approach to the Upper Harbor, the channel between the Lower Middle and Castle Island, although of ample depth, is very narrow, and vessels have to hug the shoal to keep in the best water. It was near this critical pass that

"State" and "Palmyra" rocks projected from the margin of the shoal, and occasioned disaster. These obstacles have been blasted away to the surface of the adjacent bottom.

In the original project of the Board relative to the Upper Middle Bar, which obstructed the approach to the city of Boston, the desirable width of the channel to be dredged was placed at 1,000 feet; the general government, however, for military reasons, restricted it to 600, and this width has been nearly achieved. There remains only $81\frac{1}{2}$ cubic yards of rock to be blasted out. The rock referred to is a ledge projecting about 150 feet into the new channel, and has now upon it 20 feet of water at low tide. Except the removal of the rocks from the Narrows, this cut through the Upper Middle Bar is the most important and the most appreciated improvement that the harbor has received at the hands of the general government; and it is because of the great benefit already derived from this work, that the Board is disposed to recall the attention of government to the original solicitation for a channel 1,000 feet in width.

As peace, not war, is the normal condition of our country, those purposes which belong to peace and make its preservation dear to all, should, we submit, have precedence; and therefore we trust, with returning faith in the permanence of peace, Congress may be willing to give us the broader channel which has been asked, even if forts must be strengthened and heavier guns provided. The Commonwealth, in the project for reclaiming South Boston Flats, has inaugurated a work which provides for widening the channel above this bar to twice the width deemed essential at the bar itself, or more than three times the width Congress provides for.

The Board proposes to communicate with Maj. Gen. Humphreys, the engineer-in-chief, concerning this matter, before renewing its petition to Congress.

Congress so far listened to the prayers of the Board, last winter, as to provide for a survey of Man-of-War Shoal, which obstructs the passage-way to the navy yard and other valuable frontages of the harbor. We entertain no doubt that the engineer to whom is assigned the execution of this survey, will recognize the advantage both to the naval and mercantile marine, of the entire removal of this shoal.

The Board is indebted to General Thom for the cordial manner in which he has responded to all calls for information ; and likewise to Mr. H. F. Bothfeld, the able assistant engineer, who has been, from the first, in immediate charge of the details of the works in Boston Harbor upon which we have commented. The following notices of improvements at Hingham and Plymouth harbors, and in Merrimac River, are mostly based upon Gen. Thom's notes, which appear in full in the Appendix.

Hingham Harbor.

General Thom announces the completion of the channel up to Hingham "so as to have a width not less than 100 feet, and a depth of eight feet at mean low water." The cost of this improvement was not to exceed \$10,000, and the contract for dredging having been made at the exceedingly low rate of 18 cents per cubic yard, there can be no doubt the money's worth of real advantage has been gained.

Plymouth Harbor.

In last year's report, mention was made of a contract made by General Thom for excavations in Plymouth Harbor. This contract was made at a low rate, and yet so successfully carried out, that there is now a channel 50 feet wide and six feet deep at mean low water, from the deep water near the Middle Ground to the wharves of the town. General Thom's plan is for a channel of double the width stated above, and for the rest of the work he has submitted his estimates.

In the Appendix will be found a report to the Superintendent of the United States Coast Survey, relative to the physical history of the Main Entrance Channel and bay of Plymouth, to which reference has already been made in the remarks on Green Harbor River.

Merrimac River.

"The project adopted for this river consists in so improving it by dredging and the removal of sunken rocks, that it shall have a depth of twelve feet at ordinary high water, from its mouth in Newburyport Harbor to Haverhill (a distance of fifteen miles), and thence for a distance of about four miles up

through the falls a depth of four feet in the ordinary stages of the river." This project requires now for its completion only the removal of numerous sunken bowlders from the channel near Silby's Island and elsewhere, for which there are presumed to be funds enough in the engineer's hands.

New Bedford Harbor.

The project of improvement in this harbor was the excavation of a channel 200 feet wide from the deep water near Fairhaven across the shoal to the wharves of New Bedford.

There has been actually dredged a channel 105 feet wide and 15 feet deep at low water; and, according to General Geo. K. Warren, the United States engineer in charge, only \$4,000 is now required to complete the work.

Wareham River.

The scheme of improvement for this harbor was completed in July. It provides a channel with nine feet of water at mean low tide, 100 feet wide at the narrowest place, and over 200 feet for the most part. This work has been also executed under direction of General Warren.

Taunton River.

General Warren reports that the channel is now essentially nine feet deep at mean high water, and nowhere less than 45 feet wide. There remains yet the removal of shoals and scattering rocks, mainly from the lower part of the river.

Fall River.

The original project for improving this river contemplated a gradual widening out of the new channel to 300 feet at each end through a curved part of its course. General Warren reports that a channel to the depth of twelve feet at mean low water, 100 feet, has been completed.

Further details relative to works under the direction of General Warren, will be found in the notes which he has kindly furnished, in the Appendix.

OFFICE AND FIELD WORK.

The office and field works incident to the acts and orders of the Board have been fully up to the average of former years, and have included the usual examination of plans submitted, the plotting of field notes, and the preparation of maps and sketches.

Field examinations and surveys have been made whenever the work or supervision of the Board required such data.

Special hydrographic surveys have been made in Boston Harbor, in connection with the dredging operations there, under the direction of the Board. A special survey was also made of Green Harbor River, in Marshfield, which is more particularly mentioned in another part of the report.

The Board, with their engineers, have visited such harbors and localities on the coast of the Commonwealth, and have given such hearings and investigations as the subjects and localities required.

The following details are given in the form usually submitted :—

Plans approved by the Board of Harbor Commissioners during the year 1876, for the erection of structures in or over tide-water, and licenses granted for such structures.

1. E. J. M. Hale, for leave to build a wharf in Merrimac River, at Groveland. Approved January 5, 1876.

2. Cambridge Improvement Company, for leave to fill a parcel of flats in Charles River, on the northerly side of Broad Canal, Cambridge. Approved February 2, 1876.

3. John Atkins, for leave to construct a pile wharf in Provincetown Harbor. Approved February 9, 1876.

4. Mark Googins and Albert Bowker, for leave to extend their wharf on Border Street, East Boston. Approved February 23, 1876.

5. William C. Brooks & Co., for leave to fill solid a part of their dock in Miller's River, Cambridge. Approved February 16, 1876.

6. Fitchburg Railroad Co., for leave to widen its passenger bridge crossing Charles River, on the westerly side. Approved March 15, 1876.

7. Fitchburg Railroad Co., for leave to widen its passenger bridge crossing Charles River, on the easterly side. Approved March 15, 1876.

8. Perez Cushing, for leave to extend his wharf on First Street, South Boston. Approved March 22, 1876.

9. South Boston Gas Light Co., for leave to extend its wharf on piles on First Street, South Boston. Approved March 29, 1876.

10. Peter M. Neal, for leave to extend his wharf on Beach Street, Lynn Harbor. Approved April 19, 1876.

11. Old Colony Railroad Co., for leave to build a pile bridge across Monument River, in the town of Sandwich. Approved April 26, 1876.

12. William Darton, for leave to extend his wharf on Border Street, East Boston. Approved April 26, 1876.

13. Lincoln Wharf Co., for leave to extend Lincoln's wharf in Boston Harbor. Approved May 3, 1876.

14. Caroline A. Breed, for leave to extend her wharf in Lynn Harbor, and also to dredge a channel. Approved May 17, 1876.

15. William G. Brown, for leave to extend his wharf in Ipswich River, at Ipswich. Approved May 24, 1876.

16. Charles S. Clark, for leave to change the line of sea-wall in the extension of his wharf on South River, Salem Harbor. Approved May 24, 1876.

17. City of Boston, for leave to repair and enlarge the draw-pier in Malden Bridge over Mystic River. Approved May 31, 1876.

18. The Boston, Winthrop & Point Shirley Railroad Co., for leave to construct a pile bridge in the location of its road across Belle Isle Creek, between Boston and Winthrop. Approved June 1, 1876.

19. The cities of Cambridge and Somerville, for leave to extend the outlet of the Bridge Street sewer under Cragie Bridge, in Charles River. Approved June 1, 1876.

20. George Douglas, for leave to build a pile structure for the accommodation of a ferry-boat at East Gloucester. Approved June 1, 1876.

21. Joseph O. Procter, for leave to extend his wharf on piles in Gloucester Harbor to the Commissioners' line. Approved June 14, 1876.

22. Smith and Oakes, for leave to extend their wharf on piles in Gloucester Harbor to the Commissioners' line. Approved June 14, 1876.

23. Cunningham and Thompson, for leave to extend their wharf on piles in Gloucester Harbor to the Commissioners' line. Approved June 14, 1876.

24. Swett & Co., for leave to extend their wharf on piles in Gloucester Harbor to the Commissioners' line. Approved June 14, 1876.

25. Town of Westport, for leave to construct a bridge over Westport River to Horseneck Beach. Approved June 21, 1876.

26. George Steele, for leave to extend his wharf to the Commissioners' line on piles in Gloucester Harbor. Approved June 21, 1876.

27. William H. Friend, for leave to extend his wharf in Gloucester Harbor on piles. Approved June 21, 1876.

28. City of Boston, for leave to repair, reconstruct and widen Dover Street Bridge. Approved June 21, 1876.

29. George F. Weston and Edward Harlow, for leave to extend their wharf in Plymouth Harbor. Approved July 5, 1876.

30. Dorchester Gas Light Co., for leave to build a wharf and dredge a channel on its land or flats between Savin Hill and Commercial Point. Approved July 5, 1876.

31. The Fall River Iron Works Co., for leave to extend its wharves in Taunton Great River at Fall River. Approved August 2, 1876.

32. Richard Borden Manufacturing Co., for leave to extend its wharf in Taunton Great River at Fall River. Approved August 2, 1876.

33. William H. Wonson & Sons, for leave to extend their wharf in Gloucester Harbor on piles to the Commissioners' line. Approved September 6, 1876.

34. Commissioners on Prison Point Bridge, for leave to rebuild Prison Point Bridge, between Cambridge and Charlestown District, across Miller's River. Approved September 20, 1876.*

35. Roxbury Gas Light Co., for leave to fill flats in South Bay bordering on Roxbury Canal. Approved September 27, 1876.

36. Orraz A. Taft, for leave to build a pile wharf at Point Shirley, Winthrop. Approved October 18, 1876.

37. David Low & Co., for leave to extend their wharf on piles in Gloucester Harbor. Approved October 25, 1876.

38. Samuel R. Lane, for leave to extend his wharf on piles in Gloucester Harbor. Approved October 25, 1876.

39. Amos A. Story, for leave to fill solid a portion of his wharf in Gloucester Harbor. Approved November 1, 1876.

40. Committee on streets of the city of Boston, in relation to the laying out of Eastern Avenue as far as E Street extended. Approved November 1, 1876.

41. Boston & Lowell Railroad Corporation, for leave to cover with a pile structure the space lying between its freight bridge and

* This bridge has just been completed and opened for public travel, making the last draw of 36 feet, constructed in conformity with the Act of 1870 as to the width of the draws on Charles and Miller's rivers.

wharf in Charles River at East Cambridge. Approved November 15, 1876.

42. City of Boston, for leave to build an abutment-wall and fill solid a parcel of flats now covered in part by Chelsea Bridge on the Charlestown side. Approved November 15, 1876.

43. James Mansfield & Sons and Charles H. Boynton, for leave to dredge a channel from their wharves in Harbor Cove, Gloucester Harbor. Approved November 15, 1876.

44. Heirs of William McKenzie, for leave to extend their wharf to the Commissioners' line on piles, in Gloucester Harbor. Approved November 22, 1876.

45. John G. Bennett, for leave to extend his wharf to the Commissioners' line on piles, in Gloucester Harbor. Approved November 22, 1876.

46. Old Colony Railroad Co., for leave to extend its draw-pier in its bridge across Fort Point Channel. Approved November 29, 1876.

Hearings before the Board in addition to the regular Business Meetings.

One hearing with land-owners of East Harbor, Provincetown, in relation to damages done to the meadows by the construction of the state dike across East Harbor.

Two hearings with citizens of Sandwich, in relation to the construction of a draw in the bridge of the Old Colony Railroad Company across Monument River.

Two hearings with parties who have been engaged in illegal filling of flats in Prison Point Bay, Charlestown District.

One hearing on the petition of the Cambridge Improvement Company, for leave to build temporary wharf accommodation during the progress of the work in Charles River, Cambridge.

One hearing on the petition of Albert Bowker and Mark Googins, for leave to extend their wharf on Border Street, East Boston, and to be relieved from paying compensation for tide-water displaced by said extension.

One hearing on the petition of the Fitchburg Railroad Company, for leave to widen its bridge over Charles River on both sides, and the proposed taking of land therefor covered by tide-water.

One hearing on the petition of William C. Brooks & Co., for leave to fill solid a portion of their dock in Miller's River, East Cambridge.

One hearing on the petition of Nash, Spalding & Co., in relation to widening and reconstructing the draw in Prison Point Bridge over Miller's River, by the cities of Cambridge and Boston.

One hearing with Bridge Commissioners on Cragie Bridge, on the petition of the cities of Cambridge and Somerville, for leave to extend Bridge Street sewer under Cragie Bridge to deep water.

Two hearings on the petition of Caleb H. Dolbeare, asking to be relieved from paying compensation for tide-water displaced by wharf extension in Fort Point Channel.

One hearing on the petition of William Darton, for leave to extend his wharf on Border Street, East Boston.

Three hearings on the petition of Charles H. Lewis, for extra compensation for dredging, under his contract for dredging shoals in Boston Upper Harbor.

One hearing on the petition of the town of Westport, for leave to construct a bridge from Westport Point to Horseneck Beach.

One hearing on the petition of H. Barker & Co., asking to be relieved from paying compensation for tide-water displaced by wharf structure in Charles River, near Watertown, on account of dredging from the bed of the river, to an amount equal to the amount of filling.

Two hearings on the petition of William H. Friend, for leave to extend his wharf in Gloucester Harbor.

Two hearings on the petition of the Boston, Revere Beach & Lynn Railroad Company, for license to fill two creeks on the line of its road, in the town of Revere.

Two hearings on the petition of the Eastern Railroad Company, in relation to the draw-pier built by the city of Newburyport in the bridge over Merrimac River under license of the Board.

Three hearings on the petition of E. B. Phillips, for leave to construct a plank walk on "Wales Beach," in the town of Swampscott.

One hearing on the petition of J. B. Lampar, for leave to build a pile wharf in Lynn Harbor.

One hearing on the petition of Boynton Brothers, for payment on account of dredging off Battery Wharf.

One hearing on the petition of the Roxbury Gas Light Company, for leave to build bulkheads and fill flats, etc., in South Bay, near Roxbury Canal.

Two hearings on information of Captain Cates, harbor-master of Boston, in regard to unlawful dumping of material in the channels of Boston Harbor.

Two hearings on the petition of the Cambridge Improvement Company, in regard to alleged illegal filling by the city of Cambridge, within the territory covered by their license from the Board.

Two hearings on the petition of Samuel R. Lane, for leave to extend his wharf in Gloucester Harbor.

One hearing on the petition of O. A. Taft, for leave to build a wharf at Point Shirley, in the town of Winthrop.

One hearing on the petition of Amos A. Story, for leave to fill solid a portion under his present pile wharf in Gloucester Harbor.

One hearing on the petition of James Mansfield & Sons et als., for leave to dredge a channel from their wharves in Harbor Cove to the present channel in Gloucester Harbor.

Six hearings with the contractors for the work on South Boston Flats in regard to the progress for the work.

Field Surveys.

Survey in Merrimac River, in regard to the location of a wharf structure by E. J. M. Hale of Groveland.

Three surveys off Battery Wharf, for the purpose of ascertaining amount of material dredged as per contract, and plans made thereof.

Inspection of Cotuit Harbor and South Bay, at the request of the legislative committee on harbors, in regard to a proposed inlet from the Sound to South Bay, and plans made thereof.

Survey off Chelsea Ferry, for the purpose of ascertaining amount of material dredged as per contract, and plans made thereof.

Survey off the National Dock and Warehouse Company's wharves at East Boston, for the purpose of the removal of a shoal in front of said wharves by dredging, and plans made thereof.

Survey of Green Harbor River, Marshfield, for the purpose of ascertaining alleged shoaling of Green Harbor, on account of the dike built by certain marsh-owners, under chapter 303 of the Acts of the year 1871, and plans made thereof.

Surveys on Charles and Miller's rivers, to ascertain amount of filling done by the Boston and Lowell Railroad Corporation.

Surveys in Boston Inner Harbor, including Chelsea Creek, Mystic River, Charles River, Fort Point Channel, South Bay, and Neponset River, for the purpose of mapping the different wharf and bridge structures built since 1861.

Survey in East Cambridge, for the purpose of establishing low-water mark near the Boston & Lowell Railroad freight bridge, and plan made thereof.

Survey in front of the Grand Junction and Cunard wharves, East Boston, for the proposed removal of shoals in front of said wharves, as petitioned for by the Boston & Albany Railroad Company and the Cunard Steamship Company, and plans made thereof.

Survey in Boston Harbor, for the purpose of locating the powder boats of the Oriental Powder Company.

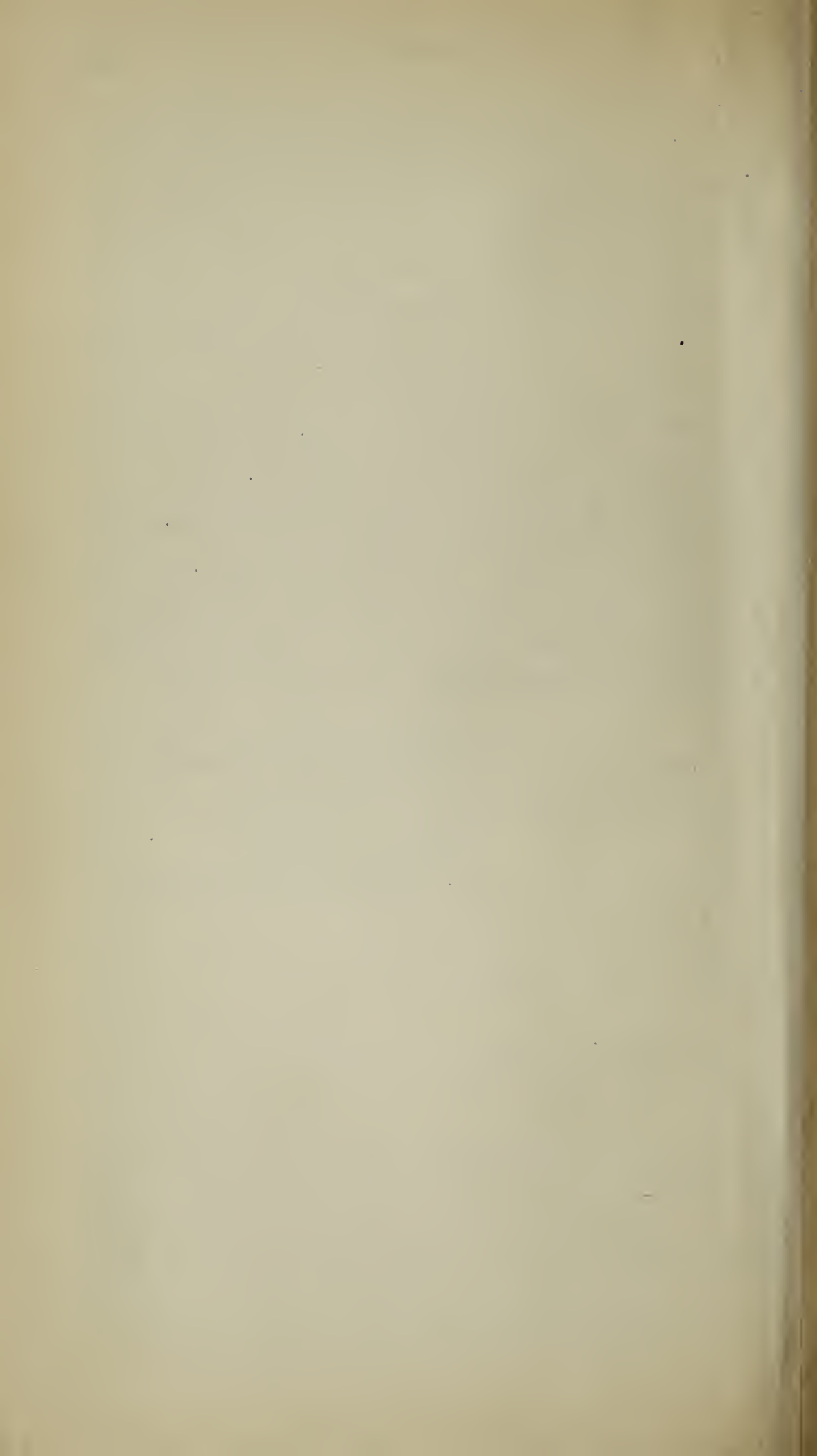
Surveys made of all structures in tide-water in Boston Harbor wherever compensation for tide-water displaced is assessed.

In addition to the work enumerated, which formally, and at regular business meetings, received the official sanction of the Board, there is almost daily intercourse with those who visit our rooms for investigation and inspection. During the last ten years, a large collection of maps and plans has accumulated of structures already completed in tide-water, which is of much importance to those who contemplate similar improvements, either in the same or other localities. Plans of seawalls, bridges, wharves (solid or on piles), and works of a kindred character, conveniently filed, are freely accessible to any citizen of the Commonwealth, and our engineers cheerfully give any information which is required.

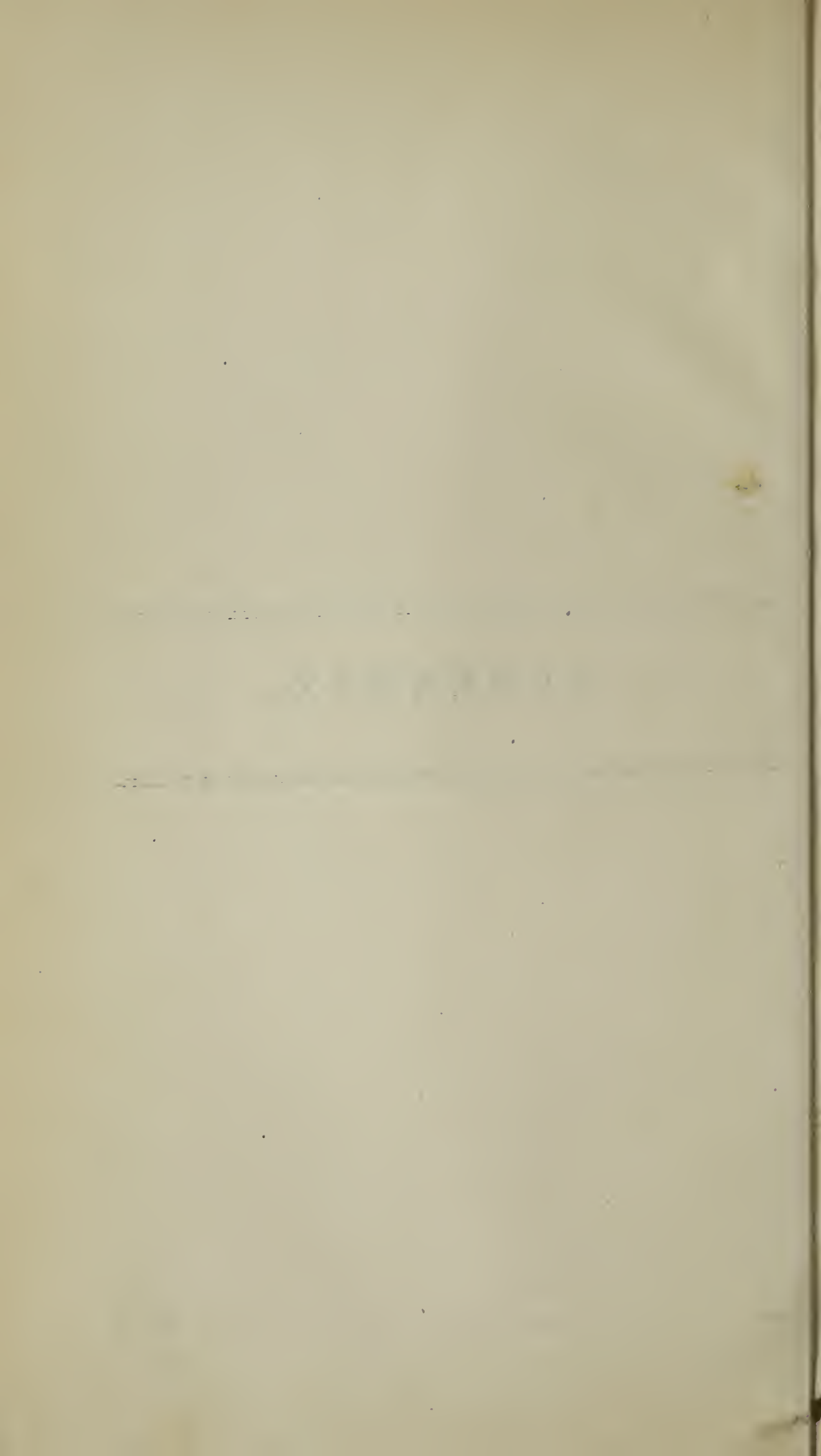
Our relations with the United States authorities in the Department of Engineers and in the Coast Survey, have been of an agreeable character and of great advantage to the interests we have in charge. We would also acknowledge the services of Mr. D. Koppmann, the long-tried and faithful assistant to the Board, and the acceptable aid of Mr. William T. Blunt, temporarily employed on surveys and plans.

JOSIAH QUINCY,
FREDERIC W. LINCOLN,
J. N. MARSHALL,
WM. T. GRAMMER,
ALBERT MASON,

Board of Harbor Commissioners.



APPENDIX.



APPENDIX.

IMPROVEMENT OF SOUTH BOSTON FLATS.

REPORT OF THE ENGINEER IN CHARGE, DECEMBER 31, 1876.

During the past year the following progress has been made by the contractors, Messrs. Clapp & Ballou. The heavy wall has been essentially completed as far east as the first dock. The light wall around this dock is finished, except a short portion where it is to be built in connection with the heavy wall east of the dock, now in progress. The heavy wall between the docks is laid up to a height of fourteen feet from its foundation, its top being now seven feet below low water. The work is progressing whenever the weather permits, and will probably be laid up to low water as soon as the weather in the spring of 1877 allows the work to be prosecuted above that level, where cement is to be used.

The work of filling has been pushed about as fast as the walls were ready to receive it. All the wall west of the first dock has been loaded, even more heavily in some places than its final load, and stands well. The portion that was built upon rip-rap has settled an average of about six inches along its whole length, since it was begun, owing to the indentation of the rough stones into the clay bottom. An allowance was made for this in adjusting the coping, so that it still stands at grade sixteen. The settlement has been so uniform along its whole length that no cracks worth naming have been developed in the cement work.

In providing material for the filling, the dredging has been done as follows:—

Fort Point Channel has been dredged to the required depth, with slight exceptions, for a width of 400 feet opposite the light wall, reaching by a gradual slope a depth of 19 feet below low water at the beginning of the heavy wall. The channel then gradually contracts in width to about 200 feet before arriving at a point opposite the first dock, increasing in depth to 23 feet below low water. Near the entrance of the first dock it has been widened again to a width of 400 feet, to allow vessels to turn in entering or leaving the dock. From this point a channel is dredged about 200 feet

wide and 23 feet deep at low water nearly due east to the main ship channel. A considerable amount of material has also been taken from the former shoal off Long Wharf. There now remains to be dredged from the first dock itself about 64,000 cubic yards, which, it is estimated, will about complete the clay filling of the 25 acres now contracted for.

Mention has been made in former reports of a timber platform to be built in front of the light walls along Fort Point Channel and the dock walls. Although such a platform was a part of the original plans, no contract has been made for its construction, it being considered as of little use until the property should be occupied for commercial purposes. But if the dock should be dredged to its full depth without building this platform, the mud and clay would be likely to slip away from the foundation piles of the wall and expose them to the attacks of the worms, which are quite destructive in these waters. The cost of building the platforms along both walls would be about \$75,000. If it be thought unadvisable to do this work at present, or preferable to leave it to be done by the future occupants of the premises, the foundation of the wall would in the meantime be fully guarded by omitting some of the dredging along the front of the dock wall or by driving a row of spruce piles along the base of the dock wall and in its front. The latter would cost about \$4,000.

The cost of the work now under contract during the successive years of its progress is given in the following tabular statement.

Respectfully submitted by

Your obedient servant,

EDW. S. PHILBRICK,

Engineer in Charge.

WORK DONE.	LINEAR FEET.		Square Feet Filling.	Total Value at Contract Prices.	Reserved under Contract.	Actually Paid.
	Light Wall.	Heavy Wall.				
Before January 1, 1875,	641	255	190,016	\$160,139 00	\$16,013 88	\$144,125 12
Up to January 1, 1876,	1,138	743	349,216	357,682 26	35,768 20	321,914 06
Up to January 1, 1877,	2,415	879	561,692	525,228 21	52,522 82	472,705 39
Remaining to be done,	165	68	284,308	195,206 79	—	—
Total when done,	2,580	947	846,000	720,435 00	—	—
Add cost of platform, if built,	—	—	—	75,000 00	—	—

HISTORICAL NOTES ON PLYMOUTH HARBOR.

[Furnished to the Board in advance of its publication elsewhere, under authority from the Superintendent of the U. S. Coast Survey.]

Boston, May 1, 1876.

DEAR SIR:—I desire to call your attention to evidences of important physical changes in the harbor of Plymouth, which are furnished by comparisons of Champlain's sketch (1605) and Blaskawitz's survey (1774) with the most recent chart of the Coast Survey.

The first of these documents is found in the published works of Champlain; the second is before me, in the original manuscript, bearing the autograph of the author, with his official title, "Deputy Surveyor for North America." *

Champlain.—The sketch of Plymouth under the name of *Port St. Louis*, may be found in Chapter VIII. of the Quebec edition.†

From the text it appears that the little vessel bearing Champlain (who was not the commander) ran into the "*cu-de-sac*," to wait for a fair wind to continue the voyage, on the 18th of July, 1605, and remained there only one day.

The positions are given upon the sketch of two anchorages, one in the middle of the roadstead, which was the first occupied, the other near the point of Long Beach. They were tempted to leave their first anchorage by the hope of going in their vessel into the "river," to which they were invited by the Indians; but they found the water too shallow, "it being low tide," and again let go their anchor.‡ This vessel drew five feet, and the sounding given on Champlain's sketch, indicating the end of the course, is one fathom; from which we learn that his depths are reduced to low water. Champlain went on shore and reconnoitred the river, and found it only an arm of the sea. He describes the bay as a place about one league in circuit—evidently meaning the "*cu-de-sac*" into which the vessel ran for an anchorage, and not the entire water-space. It is

* This manuscript map of 1774 is the property of Mrs. Mary Winslow Russell, grand-niece of the Edward Winslow to whom (as stated in the legend) it was presented by the author. This map has never been published, although the late Dr. Nathan Hayward, some ten years ago, made lithographic copies for private distribution.

† *Œuvres de Champlain publiées sous le patronage de L'Université Laval, par L'Abbé C.-H. Laverdière, M. A., 1870.*

‡ Presuming that Champlain's date is Gregorian, we have computed the tide, and find that low water, a little below the mean, occurred at 6 P. M.

this "*cu-de-sac*" that he sounded out, and although he does not represent Brown's Bank, the limits of his soundings indicate that the bank was there, but that he did not know that any ship channel lay between this bank and the Gurnet or Saquish. If this bank had been as elevated as it now is, so as to run dry at low water, he would probably have represented it on his sketch, and have guessed that the great entrance channel to interior waters lay beyond.

In the text he refers to the Gurnet as covered with wood, principally pines, and as "attached to a pretty long coast of sand dunes."

He then speaks of two "*islets in the said bay*" (evidently Saquish and Clark's islands), "*which are not seen unless one is within, around which the sea runs nearly dry at low tide.*"

Champlain's map is, in the main, a wretched eye sketch—one of the worst that appears in his narrative. He evidently did not think the anchorage a valuable one. He had gone in on the wrong side of Brown's Bank, and just missed the discovery of an excellent harbor.

Ignoring the well-deserved reputation of this very scrupulous explorer and writer, and assuming nothing for this map beyond that which would impress us in the most ordinary sailor's sketch, we still must admit that there are points of value in it. He had two instruments, a compass and a lead-line, and he evidently designed to represent two positions of his vessel in their relations to the two entrance headlands, etc.

With his compass corrected for the variation, determined by him at *Malle Barre* on the previous voyage, we find the tangents to the entrance headlands (at the shore lines) to be N. by E. one-half E. and E. S. E., while the point of Long Beach bears N. W. (true). We also observe that a considerable portion of Clark's Island is open to the westward of Saquish.

With these bearings and range, we plot the vessel upon our Coast Survey map, and find it lying two miles from Rocky Point, and over three from Gurnet Point. These two points have no doubt washed away somewhat; but with every possible allowance for waste, we cannot conclude, from the data referred to, that the anchorage place was less than one and three-quarters statute miles from the outer chord of the entrance. In his sketch, however, Champlain makes the vessel lie about mid-way between the outer chord and Long Beach, which would reduce the distance we have just given to one and a quarter miles.

Having satisfied ourselves that the vessel lay from one and a quarter to one and three-quarters miles from the entrance, let us examine the soundings he has grouped about her and extended seaward in his sketch. We find that in the circle of a half mile diameter, about the vessel, there was an average of seven and one-half

fathoms—the extremes being five fathoms, on the inside, and nine fathoms on the outside. The same circle upon the Coast Survey Chart shows a mean of about three fathoms, and nothing greater than four fathoms in 1853.

Again, we find that from his anchorage, nearly to the chord of the bay, he has numerous soundings showing that a belt, about a half-mile wide, could be followed out of the bay with a depth of nine fathoms, and that when still quite within the tangent chord of the bay (so as to be in the narrowest part of the entrance) there were ten where there are now less than six fathoms. You will observe by consulting Champlain's sketch, that he gives four soundings of ten fathoms in this neighborhood, as if to *make sure* to represent the entrance depth to this "*cu-de-sac*."

In the subjoined table we give a comparison of his soundings with those of the Coast Survey in 1853—the latest we have :—

DISTANCE FROM ENTRANCE.	DEPTH IN FATHOMS.		Loss of Depth.
	1605.	1853.	
Statute Miles—			
0.00,*	Not given.	5 $\frac{3}{4}$	—
0.25,†	10	5 $\frac{1}{4}$	4 $\frac{3}{4}$
0.50,	9	4 $\frac{1}{2}$	4 $\frac{1}{2}$
0.75,	9	4 $\frac{1}{2}$	4 $\frac{1}{2}$
1.00,	8	5	3
1.25,	7	3 $\frac{1}{2}$	3 $\frac{1}{2}$
1 50,	5	3 $\frac{1}{2}$	1 $\frac{1}{2}$

* Tangent line from Gurnet to Rocky Point. † Between entrance headlands.

It is safe to conclude from the above, that the deeper portion of the cove or bay between Brown's Bank and Rocky Point, has received an enormous deposit since the visit of Champlain.

As well as we can judge from the sketch, the depth found near the point of Long Beach was about the same in 1605 as it now is, although there can be no doubt that alterations of Long Beach itself have been in progress since that time.

There is no evidence of any general emergence of the New England coast indicated by any comparisons that we have made of Champlain's maps with those of the Coast Survey. Salt marshes indicated by Champlain in his map of Saco, Maine, are marshes still, and the depths over the rocky bottom of Gloucester, as well as in some of the lagoons of Cape Cod, remain the same now as in 1605. The Old Colony Records of very early dates abound in references to the salt marshes of Plymouth, Duxbury, and Marshfield,

which were peculiarly valuable in a country where the uplands were not yet cleared, and which still remain at level of high water. We have taken pains to investigate a little this question of emergence, because a very able geologist has recently asserted that the coast of the "Gulf of Maine" rises from one to three feet per century.

Blaskawitz (1774).—In its topographical features, the original plotting made by Blaskawitz from his survey of Plymouth, is remarkable for accuracy and beauty. It is deficient in soundings, but the depths in the principal channel-ways are given, and seem to be designed to be those of the best water at low tide.

The depths in the channel through the Cow Yard and along the main ship channel past Saquish Head, are represented much less in 1774 than upon our latest Coast Survey Chart. It is possible that the completion of the cordon of dunes connecting Saquish with the Gurnet (which has been effected since the Blaskawitz Survey) and the closing of a broad *wash-over* in the beach above Rousse's Hummocks, may have caused more water to flow in and out of the channels we have named, and induced a greater depth of water.* But we should be timid of conclusions relative to *deepening*, because our Coast Survey soundings are so much more numerous than those upon the old map, that the greatest depressions of the channel-bed are more likely to have been reached by us than by Blaskawitz.

When shoaling, instead of deepening, is indicated by the comparison of old maps with our own, we may safely conclude that a change has occurred, and this is the case presented in the lower part of the main ship channel between Saquish and the sea, to which we shall now refer.

The following table shows the comparison of depths in the lower reach of the main ship channel :—

DISTANCE IN STATUTE MILES.	DEPTH IN FATHOMS.		Loss of Depth.
	1774.	1853.	
1.00,	6	4½	1½†
0.80,	7	4¼	2¾
0.60,	8	4½	3½
0.44,	9	4¼	4¾
0.25,	9	4½	4½
0.00,	10	4¾	5¼†
0.20,	10	6	4§

* This opening above Rousse's Hummocks appears to have been dry at low tide—and is a little uncertain in the manner of its representation.

† One mile westward from tangent line, joining outer cliff of Gurnet with Rocky Point.

‡ On tangent line, joining outer cliff of Gurnet and Rocky Point.

§ Outside of tangent line above mentioned.

GENERAL CONCLUSIONS.

1. Champlain entered the outer cove of Plymouth, in 1605, with ten fathoms of water where there are now less than six; and Blaskawitz, in 1774, ran into the main ship channel of Plymouth with ten fathoms where there are now less than five.

2. Champlain, in 1605, found about four fathoms more water in the deeper portion of the outer cove than now exists; and Blaskawitz, in 1774, found about four fathoms more water, for a distance of a mile, in the outer portion of the main ship channel, than now exists.

It would be rash to conclude that the agreement of these diminutions of depth indicates that the entire change has occurred during the last century; but we drop this hint for what it is worth.

Along the western coast of Cape Cod Bay there are several fiords similar to Plymouth, but of less extent, that have been more nearly filled up with the sands of the coast. There are many thousand acres of salt meadow in Scituate and Marshfield, which are evidently formed of silt from the outside coast, where the high glacial bluffs are falling a prey to the dash of the sea; but the headlands at the entrance to Plymouth are now so defended by the bowlders that lie at their feet, that they yield very slowly. The Gurnet headland has diminished very little since 1774, and the distance from it to Rocky Point has remained about the same.

We have generally regarded the waves as the primary agents for the supply of the material filling up the re-entrant angles of our coast, not only in their direct action upon the glacial cliffs, but also in their transporting power where they drive diagonally upon the shore; but in Cape Cod Bay there is a curious action of the currents that we must not ignore. In the report of the Advisory Council of the Joint Committee of the Massachusetts Legislature on the Cape Cod Ship Canal (1860), it is stated that "the tidal party in Cape Cod Bay discovered a coastwise current which 'gave peculiar interest to the observations.' This current sweeps along the western shore of the bay, pursuing a northwardly course; it is feeble at the outlet of the canal, but it gathers strength further north, where, according to the observations, it slackened only for about two hours at the time of most rapid rise of tide. The most singular feature, perhaps, of this coast current, that fell under the observer's notice, was its very low temperature in summer." The next year after this report of the Advisory Council was made, the same party of Coast Survey observers made further investigations upon this stream. A station was occupied only about four miles south-east of Rocky Point (the southern headland of Plymouth), and there the northerly movement

was found to be about a half-mile per hour at the surface, and but little less than this near the bottom, eighty-four feet below—a velocity quite equal to the rolling of sand.

3. The material which has accumulated in the entrance to the main ship channel of Plymouth, and in the cul-de-sac below Brown's Bank, has been brought alongshore from the northward by storm seas, and has been swept from the southward, over the bed of Barnstable Bay, by a littoral current.

Very respectfully, yours,

HENRY MITCHELL, *U. S. C. S.*

CARLILE P. PATTERSON, Esq., *Superintendent U. S. Coast Survey.*

NOTE.—Copies of the sketches of Champlain and Blaskawitz will be found in the Annual Report of the Coast Survey for 1876, not yet issued. Below we give a full translation of Champlain's account of his visit to Plymouth.

“Continuation of the Discoveries of the Coast of the Almouchiquois, and what we particularly remarked there.

“The next day we doubled the Cape St. Louis, thus named by *Sieur de Mons*, moderately lowland, in latitude $42\frac{3}{4}^{\circ}$, and made this day two leagues of sandy coast; and passing along this, we saw there a quantity of cabins and gardens. The wind being contrary, we entered into a *cu-de-sac* to await proper weather to make our route. There came to us two or three canoes, which came from fishing cod and other fish which occur there in quantity, which they fish with shafts (?) made out of a piece of wood into which they fasten a bone which they form in fashion of a harpoon and tie very carefully for fear that it should pull out, the whole being in the form of a little hook; the line which is attached to it is made from the bark of a tree. They gave me one of them, which I took from curiosity, where the bone was attached by hemp, in my opinion like that of France, and told me that they gathered this herb in their country without tillage, and showed me the height to be four to five feet. The said canoe went back to the land to notify those of his household, who made smoke (as signal?) and we perceived eighteen or twenty savages, who came to the border of the sea and began to dance. Our boat went on shore to give them bagatelles, with which they were well pleased. There came down to us others who prayed

us to go into their river. We weighed anchor to do so, but we could not enter because of the little water which we found there, it being low tide, and were constrained to anchor at the entrance. I went on shore, where I saw many others, who received us very graciously, and reconnoitred the river, which is nothing but an arm of the sea, which extends a little distance inland, which is in part deserted, within which is a brook which is not navigable for boats except at high tide.

“This place may be a league in circuit. At one of the entrances of it there is a kind of island (?) covered with wood, and principally with pines, which is attached to a pretty long coast of sand dunes; the other coast is a pretty high country. (*A promontory seen four or five leagues at sea*, is the purport of the legend on the sketch.) There are two islets in said bay, which one sees not if one is not within, around which the sea nearly drains out at low tide. This place is very remarkable from the sea, inasmuch as the coast is low, except the cape of the entrance of the bay, which we named the port of the Cape St. Louis, distance from the said cape two leagues, and ten from the *Cap aux isles* (Cape Ann). It is about in the same latitude as Cape St. Louis.*

“The 19th of the month we left this place. . . .”

* The latitude stated is 45 miles too high. If Champlain had not illustrated the above narrative by a sketch, it would, by itself, be scarcely more comprehensible than the Sagas relating to the voyages of Leif and Thorwald in the same neighborhood *probably*.

LIST OF PROPRIETORS

TO WHOM PAYMENT HAS BEEN MADE BY THE COMMONWEALTH IN
SETTLEMENT OF THEIR RIGHTS TO MARSH LANDS IN EAST HARBOR.

Proprietors of East Harbor Meadow,	\$1,820 00
Thomas F. Small,	983 47
Isaac M. Small,	751 13
Jesse Collins,	65 88
J. G. Thompson,	119 39
Asa Sellew <i>et als.</i> ,	28 31
Atkins Hughes,	64 96
Wm. Chandler,	27 45
S. T. Eastman,	45 60
Isaac Green,	23 18
Francis Small,	56 36
T. K. Small,	101 10
Isaac Small,	185 28
Jesse Paine,	32 94
E. C. Kilburn,	111 93
Sarah Larkin,	101 50
Solomon Bangs,	48 40
Jesse Collins,	28 06
Amos Coan,	76 86
J. S. Dyer,	96 80
John Hughes,	89 34
Heirs of J. A. Mayo,	129 62
Enos Nickerson,	77 44
Jesse Paine,	18 14
Thomas D. Smith,	100 49
Heirs of John Smith,	186 80
S. K. Hopkins,	120 32
David D. Smith,	114 06
Asa Sellew,	108 91
Heirs of James Hughes,	233 78
Heirs of J. Small,	134 50
Wm. Holden and Wm. Holden, Jr.,	283 92
Wm. Holden, Jr., and Wm. Holden,	25 16

Thomas Small,	.	.	.	.	.	.	.	\$117	61
D. S. Small,	.	.	.	.	.	.	.	63	28
Heirs of Edw. Armstrong,	.	.	.	.	.	.	.	110	93
Edgar Paine,	.	.	.	.	.	.	.	83	41
Isaiah Gifford,	.	.	.	.	.	.	.	449	37
Joanna C. Myrick,	.	.	.	.	.	.	.	54	44
W. H. Collins,	.	.	.	.	.	.	.	47	52
D. D. Smith,	.	.	.	.	.	.	.	55	51
Wm. Chandler,	.	.	.	.	.	.	.	57	49
Francis Small,	.	.	.	.	.	.	.	170	92
Reuben Atkins,	.	.	.	.	.	.	.	170	52
Jonah Stevens <i>et als.</i>,	.	.	.	.	.	.	.	182	54
Seth Nickerson,	.	.	.	.	.	.	.	46	01
Heirs of Jonathan Nickerson,	.	.	.	.	.	.	.	174	24
J. P. Johnson,	.	.	.	.	.	.	.	65	32
Heirs of Nehemiah Nickerson,	.	.	.	.	.	.	.	78	65
Heirs of Simeon Conant and Eben. Atkins,	.	.	.	.	.	.	.	76	25
Mercy M. Lewis,	.	.	.	.	.	.	.	103	70
J. H. Bird,	.	.	.	.	.	.	.	28	97
Thomas Lewis,	.	.	.	.	.	.	.	133	42
R. O. Watkins,	.	.	.	.	.	.	.	88	08
Stephen Nickerson,	.	.	.	.	.	.	.	107	20
								\$8,856	46

ABSTRACT OF REPORT OF GEN. GEORGE THOM TO
THE CHIEF OF ENGINEERS, FOR 1876.

IMPROVEMENT OF BOSTON HARBOR, MASS.

Operations for the improvement of this harbor were suspended for the winter in November last. The work done during the past season of 1876 has been as follows, viz :—

1. *At the Upper Middle Bar.*

This improvement consists in straightening, widening, and deepening the main ship channel for a distance of fifteen hundred (1,500) yards across the bar, for a width of six hundred (600) feet, and to a depth of 23 feet at mean low water, or about 33 feet at mean high water. Dredging operations were resumed at this place on the 3d of May last, by the Atlantic Dredging Company, of Brooklyn, N. Y., under contract of March 5, 1874, and continued until the 11th of July, when the contract was completed by 90,859½ cubic yards of dredging. On the 9th of May last, Messrs. Curtis, Fobes & Co., of Portland, Me., also commenced dredging at this place, under their contract of May 19, 1875, for 90,000 cubic yards, more or less, of dredging, which was continued by them without interruption until the 16th of November, when the contract was completed by 88,150½ cubic yards of dredging. On the 10th of June, work was commenced by the Harbor Improvement Company, of Boston, under contract of September 1, 1874, on the removal of several sunken ledges which were laid bare by their dredging operations of the previous year on the Upper Middle Bar; which ledges were completely removed to the required grade of 23 feet below mean low water, on the 26th of August,—containing, altogether, 37 cubic yards,—in completion of the contract.

Under the above-named contracts, together with the previous ones made and completed since 1870, *all the dredging* required at the Upper Middle Bar has been completed, amounting altogether to 268,278½ cubic yards; and about 50 cubic yards of sunken ledges and bowlders have been broken up and removed to grade. The only shoal part of the channel at this place which, after about 31,500 soundings, has been found to require further improvement, is a sunken *ledge* laid bare by dredging. It is about 300 yards

above (westward of) black buoy No. 9, and extends 150 yards into the channel on its southern side, covering an area of about 230 superficial yards in the plane 23 feet below mean low water, with about 20 feet of water over its shoalest part at mean low water. The removal of this ledge to grade will require about $81\frac{1}{2}$ cubic yards of excavation.

2. *West End of Great Brewster Spit.*

The work for the improvement of the main ship channel at this place consists in the excavation, by dredging and otherwise, of the southern portion of this spit, so as to obtain a depth of 23 feet at mean low water, for a width of not less than 600 feet. The dredging required at this place commenced in August, 1875, by the New England Dredging Company, of Boston, under contract of September 3, 1874, leaving to be done for its completion the breaking up and removal of $95\frac{1}{2}$ cubic yards of ledge which had been laid bare above grade by the dredging. This work was commenced in the latter part of May, 1876, and was finished on the 8th of November; which, with the dredging (viz., 29,225 cubic yards) previously done under the same contract, has completed all the improvements projected at this place.

3. *Nash's Rock Shoal.*

This shoal lies in the entrance of Boston Harbor, about one-third of the way across from Brewster Spit to Point Allerton. It has an area of about nine acres above the 23 feet plane, and is composed of bowlders (some of which are very large), shingle, gravel, hard-pan, etc., etc. The improvement projected for this place is to reduce the shoalest portion of the shoal to a depth of 21 feet at mean low water, and to remove all the dangerous rocks from its surface. Under the contract made May 19, 1875, with Messrs. Curtis, Fobes & Co., of Portland, Me., this work was partially finished in September last, leaving still to be done, under some new contract, about 50 cubic yards of dredging, and about 100 cubic yards of bowlders to be broken up and removed.

4. *Repairs of Sea-walls.*

Sea-walls have been built for the protection and preservation of the headlands in this harbor, at Point Allerton, Great Brewster Island, Lovell's Island (north head and south-east bluff), Gallop's Island, Long Island (north head), and Deer Island (north, middle, and south heads). All these sea-walls, with the exception of that on the south-east bluff of Lovell's Island, and those on Deer Island, are in good condition. During the months of October and Novem-

ber, all the necessary repairs were made on these sea-walls, excepting that on the south-east bluff of Lovell's Island. For raising and repairing this wall, an estimate for an appropriation was submitted in my last annual report.

5. *Removal of Sunken Rocks.*

The removal of Kelly's Rock, Tower Rock, Corwin Rock, and of a sunken ledge recently discovered between George's Island and Great Brewster Spit (all situated in the main ship channel at "The Narrows"), had all been removed in September, 1875, to a depth of 23 feet at mean low water, as stated in my last annual report. Barrel Rock, in Broad Sound, and State and Palmyra rocks, on the southern edge of the Lower Middle Bar (about one-half a mile east of Castle Island), have also been removed; so that the only work that now remains to be done for completing all the contemplated improvements in this harbor consists of the following, viz. :—

1. Straightening, widening, and deepening the main ship channel at the south-west point of Lovell's Island, at an estimated cost of	\$16,000 00
2. Completing the improvement of Nash's Rock Shoal, say	5,000 00
3. Removal of ledges recently discovered above and below Kelly's Rock, say	11,340 00
4. Removal of ledge recently discovered in the main ship channel, at the Upper Middle Bar.	5,000 00
5. Removal, by dredging, of Man-of-War Shoal, say	39,000 00
6. Repairing sea-wall on south-east bluff of Lovell's Island, estimated at	15,000 00
Engineering expenses, and other contingencies, say	13,135 00

Total, \$104,475 00

Amount appropriated by Act of Congress, approved August 14, 1876 (\$50,000), less amount since expended is, say 44,475 00

Additional amount required for completing all the contemplated improvements in this harbor, . . . \$60,000 00

IMPROVEMENT OF HINGHAM HARBOR, MASS.

By Act of Congress, approved March 3, 1875, provision was made for the improvement of this harbor, the cost not to exceed \$10,000. The project adopted for this improvement consisted in straightening, widening and deepening the channel, so as to have a width not less

than one hundred feet and a depth of eight feet at mean low water, or about six feet at low water of spring tides, the mean rise and fall of the tides being nine and a half feet.

Under a contract made with Messrs. Curtis, Fobes & Co., of Portland, Me., 25,160 cubic yards of dredging (at 18 cents per cubic yard) was done by them, which they completed on the first of May, 1876; and under contracts made with Mr. George W. Townsend, of Boston, Mass., ninety-two cubic yards of sunken ledge was removed from the channel, which was also completed in May last.

This completes all the improvement projected for in this harbor.

IMPROVEMENT OF MERRIMAC RIVER, MASS.

The project adopted for this river, consists in so improving it by dredging and the removal of sunken rocks, that it shall have a depth of twelve feet at ordinary high water, from its mouth in Newburyport Harbor, Mass., up to Haverhill (a distance of fifteen miles); and thence for a distance of about four miles up through "the falls," a depth of four feet in the ordinary stages of the river. During the past season, work has been carried on, for this purpose, as follows; viz. :—

1. The channel has been opened for a width of one hundred feet, and to the projected depth through "Currier's Shoal," about five miles below Haverhill, Mass.

2. The channel has been opened for a width of about seventy-five feet, and to the projected depth through the shoals, near the head and foot of Silby's Island, from one to two miles below Haverhill.

3. The shoal at Haverhill, between the bridges, has also been improved, so as to have a channel ten feet in depth at ordinary high water; and

4. Numerous large bowlders have been removed from the channel at "the falls" above Haverhill.

These operations were continued until the last of October, when they were suspended for the winter on account of freshets and ice.

These improvements, together with those made in 1875, near Rock's Bridge, by the removal of Petty Rock, Little Currier Rock and shoals above and below the bridge, have been such that the only work that now remains to be done for completing the improvement of this river above Newburyport Harbor, as now projected, consists in the removal of numerous sunken bowlders from the channel near Silby's Island and elsewhere, for which the funds now available are believed to be sufficient.

For the projected improvement in Newburyport Harbor, the additional appropriations asked for in my last annual report will be required.

PLYMOUTH HARBOR, MASS.

The improvement projected for this harbor consists,—

1. In the protection and preservation of Long Beach, which affords the only shelter the harbor has from easterly storms; and

2. In opening through the shoals a towing channel, one hundred feet in width and six feet in depth, at mean low water (or sixteen feet at mean high water), from deep water near the Middle Ground up to the wharves of Plymouth.

The various works that have been built from year to year upon Long Beach, have strengthened and extended it to such an extent as to afford all the desired protection to the harbor, with a prospect of its being permanent, if by proper and seasonable repairs it shall be kept in its present efficient condition.

Under the appropriation of \$10,000 made by Act of Congress, approved March 3, 1875, for improving the channel of this harbor, a contract was made with Mr. Augustus R. Wright, of Geneva, N. Y., for the dredging, at twenty-three cents per cubic yard, which he completed in June last by 34,985 cubic yards of dredging; whereby a channel has been opened up to the wharves of Plymouth, for a width of fifty feet, to a depth of six feet at mean low water. An estimate for completing the improvement of this harbor has been submitted, with a view to obtaining an appropriation therefor by Congress.

ABSTRACT OF REPORT OF GEN. G. K. WARREN TO THE CHIEF OF ENGINEERS, 1876.

NEW BEDFORD HARBOR, MASS.

In the months of July, August, September, and October, 1875, a channel 105 feet wide was dredged from the deep water near Fairhaven wharves, across the shoal to the wharves at New Bedford.

The depth secured was 15 feet at mean low water. The mean rise of the tide is about three feet. The completed project is for a channel of the above depth 200 feet wide, for which, according to the original estimate, \$4,000 additional is required.

Financial Statement.

Amount in treasury of the United States, July 1, 1875,	\$10,000 00
Amount expended in the fiscal year ending June 30,	
1876,	9,926 13
Amount available July 1, 1876,	73 87
Amount appropriated by Act approved Aug. 14, 1876,	10,000 00
Amount estimated to complete project,	4,000 00

Dec. 1, 1876. The expenditure of the appropriation of \$10,000, made by Act of Aug. 14, 1876, has not been authorized.

HYANNIS HARBOR, MASS.

There being no sufficient means available for this work, nothing was done during the past fiscal year. To complete the strengthening of the work at the breakwater, will require an appropriation of \$10,000. Besides this, the lighthouse should be moved to the east end of the breakwater.

Financial Statement.

Balance in treasury of the United States, July 1, 1875,	—
Amount in hands of officer, subject to his check, July	
1, 1875,	\$42 94
Amount expended during the fiscal year ending June	
30, 1876,	—
Amount required to complete the existing project,	10,000 00

WAREHAM HARBOR, MASS.

The continuation of the dredging under the last appropriation, was unavoidably delayed until June 6, 1876. It has since made rapid progress, and will be completed in July. There will then be a channel up to the wharves nine feet deep at mean low water, having a width of 100 feet in the narrowest part, and throughout the greater part of the harbor 200 feet or more. The mean rise of the tide is about four feet.

Financial Statement.

Balance in treasury of the United States, July 1, 1875,	\$10,000 00
Amount expended during fiscal year ending June 30,	
1876,	2,975 22
Amount available July 1, 1876,	7,024 78
Amount required for completing project,	—

Dec. 1, 1876. This improvement was completed in July.

TAUNTON RIVER, MASS.

The work under the last appropriation of \$10,000, approved March 3, 1875, which consisted in dredging and removing rocks from the channel, has all been completed except the removal of some pieces of blasted rock, which will be done in July. After this is done, there are shoal places and scattering rocks to be removed requiring an appropriation of \$5,000. The channel is now essentially nine feet deep at mean high water, in the narrowest cuts 45 feet wide, and in others 60 feet wide. This river is not navigated at low tide in the upper part.

Financial Statement.

Balance in treasury of the United States, July 1, 1875,	\$10,000 00
Amount expended in fiscal year ending June 30, 1876,	8,794 10
Amount available July 1, 1876,	1,205 90
Amount estimated to complete existing project,	5,000 00

Dec. 1, 1876. The removal of blasted rock was completed in August.

FALL RIVER HARBOR, MASS.

The work under the last appropriation has completed the projected channel to a width of 100 feet, and depth of 12 feet at mean low water. The mean rise of the tide is about $4\frac{7}{10}$ feet.

The original project contemplated a gradual widening out of the new channel to 300 feet at each end, this increased width being through a curved part of its course.

Financial Statement.

Balance in treasury of the United States, July 1, 1875,	\$10,000 00
Amount in hands of officer, subject to his check, July	
1, 1875,	4,386 77
Amount expended during the fiscal year ending June	
30, 1876,	13,789 22
Amount available July 1, 1876,	597 55
Amount appropriated by Act of Congress, approved	
Aug. 14, 1876,	10,000 00

Dec. 1, 1876. The expenditure of the appropriation of \$10,000, made by Act of Aug. 14, 1876, has not been authorized.

BOSTON & ALBANY RAILROAD COMPANY, }
BOSTON, November 27, 1876. }

To the Honorable Board of Harbor Commissioners.

In behalf of the Boston & Albany Railroad Company, I respectfully represent that the docks and wharves of said company in East Boston, with the elevator and storehouses connected therewith, furnish at the present time a very large proportion of the facilities for the foreign commerce of Boston. I send to you herewith a plan of the Grand Junction wharf property at East Boston.

Dock No. 6, upon which the elevator is situated, has a depth of water of 23 feet at low tide. There are frequently two and there have been at times three large steamers discharging or receiving freight at the same time in this dock. The depth of the water opposite the dock, outside of the Commissioners' line and in the channel, is but about 18 feet at low tide. The largest steamers cannot therefore, at low water, pass from the dock over this bar or shoal into the ship channel.

The company which I represent have formerly dredged at their own expense in front of their docks to make them reasonably accessible. We understand that your honorable Board have caused the obstructions before the docks in other parts of the harbor to be removed and the water to be deepened at the expense of the State. The importance and even necessity of similar work at East Boston is more urgent. If at any time, when a loaded steamer was in this Dock No. 6, the elevator should take fire, with the tide nearly out, there would be no power to haul the steamer out of the dock to a place of safety. And, on the other hand, if the steamer should take fire, the elevator would be exposed to a like danger, with no means of protection.

I need not enlarge upon the nature and extent of the calamity which such an occurrence would cause, not only to the parties more specially interested, but to the reputation and commercial interests of the port.

I shall be ready to make any further representations, or furnish any additional information upon the subject, which the Commissioners may require.

What is required, is, that sufficient dredging should be done outside of the Harbor Commissioners' line to enable the steamers of the heaviest draught, when loaded, to float at low tide.

I am, very respectfully, yours,

D. WALDO LINCOLN,
Vice-President.

CUNARD STEAMSHIP OFFICE,
99 STATE STREET, BOSTON, December 5, 1876. }

To the Honorable the Board of Harbor Commissioners, Boston.

GENTLEMEN:—On a recent outward-bound trip from this port to Liverpool, the mail steamship “China,” after leaving her moorings at the Cunard wharves, East Boston, and proceeding out of dock, grounded on a bank in the harbor, which is situated about 150 feet to the westward of the northern corner of the Cunard wharf, East Boston. This bank has been gradually forming during some years past. It appears to consist of the natural deposit of the channel which sweeps over it, on the East Boston side of the harbor. There is only a depth of about 15 feet of water over it at low water. The “China,” loaded, draws about 22 feet 6 inches. This vessel again sailed from Boston on Saturday the 25th ulto., and was on this occasion detained half an hour beyond her advertised time of sailing, because the pilot in charge of her considered the bank an obstruction to her safe navigation.

I respectfully refer to the pilot (Captain Harrington) and the harbor-master (Captain Cates) in verification of these statements, and if this application, confirmed by them, is satisfactory to your honorable Board, hereby petition that said bank may be removed by dredging.

I send with this a plan of the Cunard wharves, East Boston, showing a depth of water around them, dredged by the proprietors, of from 22 to 23 feet at low water.

Yours, very respectfully,

JAMES ALEXANDER,
Agent Cunard Steamship Company.

[Chapter 122, 1876.]

AN ACT

RELATING TO THE PASSAGE OF VESSELS THROUGH DRAWBRIDGES.

Be it enacted, &c., as follows:

SECTION 1. Any city or town in which a draw for the passage of vessels through a bridge used as a public highway and maintained at the public expense, is situated, shall have power to make ordinances or by-laws regulating the passage of vessels through such draw, and to annex penalties not exceeding fifty dollars for each violation thereof: *provided*, such ordinances or by-laws shall be approved by the harbor commissioners.

SECT. 2. In all cases where such ordinances or by-laws are made applicable to any draw, it shall be the duty of such city or town to place said draw under the direction of a suitable person or persons, as draw-tender or superintendent, and to post in some conspicuous place near by, a written or printed copy of such ordinances or by-laws.

SECT. 3. Such draw-tender or superintendent shall have full control of the passing of all vessels through the draw, shall furnish all facilities for such passing, shall allow no detention, having due regard for the public travel, and shall enforce the ordinances or by-laws aforesaid.

SECT. 4. If any vessel shall, through the negligence of the master or others having charge of her, or their neglect to comply with such ordinances or by-laws, or disregard of the directions of such draw-tender or superintendent, injure any bridge, draw or pier or wharf connected therewith, the owner or owners thereof shall likewise be liable to pay for such damage, to be recovered by such city or town in an action of tort.

SECT. 5. Such draw-tender or superintendent shall likewise have authority to remove any vessel obstructing such draw, or interfering with the passage of other vessels through the same, or made fast to such draw or bridge or pier or wharf connected with the same, without the consent of such draw-tender or superintendent, or wilfully violating any ordinance or by-law, and the expense of such removal shall be recovered in the manner set forth in the foregoing section.

SECT. 6. This act shall take effect upon its passage.

Approved April 6, 1876.

